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Practical and Theoretical Mechanics.

Report of Experiments made by the Committee of the Franklin Institute of Pennsylvania, on the Explosions of Steam-Boilers, at the request of the Treasury Department of the United States.

The Committee of the Franklin Institute on the Explosions of Steam-Boilers, respectfully present to the Secretary of the Treasury, their report of the experiments undertaken at the request of the department. The queries which were submitted by the committee, to the officer at whose request the experiments were instituted,* have formed the basis of the labours of the committee. They have, however, availed themselves of the privilege accorded, of trying such other experiments as might grow out of the investigation, or as they might deem of special interest.

The object of the experiments was to test the truth or falsity of the various causes assigned for the explosions of steam-boilers, with a view to the remedies either proposed, or which may be consequent upon the result of the investigation. The causes being accurately known, the attention of ingenious men is led away from false suppositions, which can only waste their time and talent, if taken as the basis of their plans for safety; greater hope is afforded of an efficient remedy; applications of an indirect, or it may be of a positively injurious sort, are avoided; and if the causes be found to be such as for the present, to baffle ingenuity in their removal, the attention is directed more fixedly towards the means of protection against the effects of such accidents. The committee hope that the results of their inquiries will not be found without fruit.

It was the aim of the committee to provide for the experiments an apparatus of such dimensions as to furnish results applicable to practice, without being so great as to be managed with difficulty, or to increase, unnecessarily, the danger incident to parts of the investigation. To arrange the apparatus and complete the details, they secured the services of an able and experienced

* The Hon. S. D. Ingham, late Secretary of the Treasury of the United States.

mechanic, David H. Mason, by whom, or under whose direction, the nicer parts of the work were executed, and who assisted, also, in the experiments.

The committee propose first to give a general description of the apparatus used, followed by details in the more complex parts; next to report the results of their examination upon each of the questions proposed for investigation.

GENERAL DESCRIPTION OF THE APPARATUS.

The boiler used by the committee, and represented in Plates 1, 2, and 3, was twelve inches in interior diameter, two feet ten and a quarter inches in length within, and one-fourth of an inch thick; of rolled iron, with the heads rivetted in the usual manner. Plate 1 is a side view, and 2 and 3 are end views of the boiler, and of the apparatus connected therewith. The boiler was placed horizontally in a furnace, the fire surface extending about half way round the cylinder.

The furnace was arranged for a charcoal fire, the grate bars extending the whole length of the boiler, and the fire being applied through nearly the whole length. The draught entered by an opening, closed in the usual manner, and left the furnace through a flue placed at one end and side of the boiler. It will be convenient to use the terms fire end or front of the boiler, in reference to the proximity to the furnace door, and back end of the boiler. In Plate 2, A is the ash-pit door, B the furnace door, and in 1 and 3, C is the furnace chimney.

In order to examine, readily, the interior of the boiler during the progress of the experiments, each head was provided with a glass window, (D, Plates 2 and 3.) The glass used was three-eighths of an inch thick. The openings in the ends, which were rectangular, were two and a half by one and three-quarter inches wide. At first a glass plate, rather larger than the rectangle just mentioned, was applied to the opening, and kept in its place by four strips of brass secured to the heads, on which a rectangular frame, having the surface next to the glass accurately ground, was secured; the pressure of the steam keeping the glass against this frame, closed the boiler. Fractures occurring frequently from the rapidly varying, and often considerable, pressures within the boiler, and taking place by pressing the middle part outwards, as was proved by examining the fractures, frames with cross bars, see Plates 2 and 3, having the interior surface carefully ground, were used. The difficulty of properly adapting the surface of these frames to the glass having been removed, they were used in the later experiments, and were found to afford a sufficiently good view of the interior of the boiler, notwithstanding the obstruction by the cross bars.

Three gauge cocks were placed in the front head of the boiler; their positions will be particularly stated hereafter; they are shown in Plates 1 and 2, at *a*, *b*, and *c*.

To the same head and by the side of the gauge cocks, a glass water gauge (*w*, *x*, Plates 1 and 2) was attached, a particular description of which will be given in the detail of experiments made to compare its performance with that of the gauge cocks.

To supply the boiler with water, a forcing pump E E' F G, Plates 1 and 3, was placed near the back end. This pump was of the ordinary construction, with a solid plunger and conical valves; the diameter of the pump was one inch, and the play of the piston one inch and three-quarters. The diameter of the pipe, F G, by which the water was conveyed from the pump to the boiler, was three hundredths of an inch. By a coupling screw, this pipe could be connected with either of the stop cocks, *d*, *e*, Plate 3, in the back end of the boiler: the opening of these cocks was two hundredths of an inch in diameter.

To ascertain the elasticity of the steam within the boiler, a closed steam gauge (H, Plates 1 and 3) was used, a particular description of the construction, &c. of which will be given. This instrument was placed upon the same stand (I, Plates 1 and 3) which supported the pump, so that the same experimenter could observe its indications and attend to the working of the pump. The cistern of the gauge was connected by a flexible pipe, *f*, *g*, with the upper part of the boiler.

The safety valve is shown on the top of the boiler, (K, Plate 1,) midway between the heads. The graduation of it required much pains, and will receive a separate discussion.

Near the safety valve is represented at L, Plates 1 and 3, the fusible plate apparatus, consisting of a sliding plate of iron, moved by a lever. On the other side of the safety valve are the thermometers, M and N, Plate 1, plunged into iron tubes to give the temperature of the steam and water within the boiler. Above this appears the reservoir, O, containing the water intended to maintain the scales of the thermometers at a constant temperature. All these parts require a more detailed description.

DETAILS OF THE APPARATUS.

Of the Steam Gauge.

The steam gauge consisted of a glass tube closed at the upper, and open at the lower end, which passed steam-tight into a reservoir for mercury: when this reservoir was connected wth the boiler the pressure of the steam raised the mercury into the gauge tube, compressing the air which the tube contained. The first mercurial gauge which was made was broken by a sudden access of surcharged steam, in the experiments upon that subject, and was replaced by a second one. The method of graduation, and in general the description of the second gauge, will serve also for the first; the details, only, varied slightly.

The glass gauge tube was 26.43 inches in length. To the lower end was connected an iron ferule, terminated above by a projecting ring. This ring was pressed upon the upper end of the pipe, *h*, Plate 1, by a coupling screw, which served to form a tight juncture between the gauge and the cistern. The cistern *i* was a cylindrical vessel of cast iron, having the two projecting tubes *h* and *k* upon which screws were cut; the first of them has been alluded to as giving a passage to the glass tube of the gauge; the second was coupled by the pipe *f g*, Plates 1 and 3, to the boiler.

The gauge tube was not of precisely equal diameter throughout, and it was judged more accurate to graduate small portions of it into equal volumes. This was done by introducing equal measures of air from the point of a sliding-rod gas measure (Hare's); this operation was performed repeatedly, and by multiple measures to verify the results, until the marks made for the equal volumes, on a paper scale attached to the tube, coincided, in the various trials. The lengths of the spaces occupied by the equal volumes were then carefully measured upon the brass scale to be used with the gauge. The slight differences between the lengths given by adjacent parts of the tube, showed that it might be considered as divided into so many small portions of uniform diameter. The mercury rising into the gauge tube from the cistern when pressure is applied, the level of the cistern is necessarily depressed; the amount of the correction for this depends upon the relation between the areas of the cistern and tube, supposed uniform. The areas of the cistern were found to be, within the limits of its use, sensibly the same; those of the tube might be so assumed for such a purpose: the ratio was therefore found by filling the gauge tube with mercury, and pouring this into the cistern, noting the rise produced; comparing this with the mean length of the tube, the ratio of depression in the gauge for elevation in the tube was found to be as .01 to 1. The air within

the tube was next carefully dried by the introduction of a receptacle of chloride of calcium, of the same length with the tube;* the air having been in contact with this substance for a sufficient time, the receptacle was withdrawn through the mercury over which the drying had been effected; the tube was next placed over a dish of mercury, in the receiver of an air pump, and the air withdrawn until on re-admitting air to the receiver, the mercury rose in the tube above the iron ferule.

The gauge tube was next introduced into the cistern, the level of which corresponding to the zero of the brass scale was then arranged, and the point of the scale at which the mercury stood was ascertained, the barometer and thermometer being noted.

It was intended in the experiments to keep the pipe from the gauge to the boiler cool, so that it might contain water, and thus give a nearly constant pressure upon the mercury of the cistern,† besides preventing the exposure of the apparatus to heat; the height of this column, above the level of the cistern, was therefore ascertained, after the gauge was put in place by screwing the cistern *i* to the stand.

All the elements for calculating the elasticity of the steam within the boiler, from the height of the mercury of the gauge, were thus known; the temperature of the apparatus being supposed constant.

The elastic force of the steam within the boiler, together with the column of water in the steam pipe, balances the elasticity of the compressed air within the gauge, together with the column of mercury above the level of that in the cistern. This level is not the original zero, but lower than that by the depression produced by the rise of mercury in the gauge tube. The depression of the mercury changes the level above which the pressure of the column of water in the steam-pipe, is measured, but the change in the pressure, by the column of water, is altogether inconsiderable. The law of the elastic force of dry air, which has been recently shown, by Dulong and Arago, to be accurate, at pressures from one to fifty atmospheres, was made use of in determining the elasticity of the air in the gauge: this elasticity is inversely as the space occupied by the air. From the data already obtained and upon the principles just stated, a table was calculated by which the observed heights of the gauge were converted into the corresponding pressures in inches of mercury or in atmospheres. The calculations were rendered rather tedious by the unequal diameter of the bore of the tube, on account of which equal lengths did not correspond to equal volumes. The usual method of calculation was resorted to, namely, to determine, by rigid calculation, the pressures, for points sufficiently near each other, and then to interpolate for intermediate heights.

The foregoing remarks take for granted that the temperature of the air in the gauge, as well as that of the mercury, remains constant; to secure this, an arrangement was adopted similar to that employed by Dulong and Arago for the same purpose. The gauge and scale were surrounded by a glass tube, *l*, Plates 1 and 3, cemented below into a brass cap, *m*, Plate 1, which had an opening in the side, communicating with a discharge pipe, *n*, Plates 1 and 3. The tube was attached above by an air-tight juncture to a tin vessel, P, of considerable capacity, compared with the tube. Water being introduced into the glass tube surrounding the gauge, the flow through this tube was regulated by

* By this method, each volume of air in the tube was in contact with nearly a twelfth of its bulk of the chloride.

† This and very many of the other precautions to insure accuracy, are borrowed from the able memoir of Dulong and Arago on the elastic force of steam at different temperatures; the result of their labours, as members of a Committee of the French Academy. Those who have engaged in questions of research will know that too great care cannot be taken to prevent the introduction of error, even in researches where great nicety may not be considered essential.

a stop-cock, *o*, placed at the end of the discharge pipe, the cistern above being filled with water.

To ascertain the temperature of the column of water surrounding the gauge, a thermometer, *p*, Plate 3, with a very small bulb was attached to the scale at the middle of its height: by this instrument, the flow of water through the casing of the gauge was regulated so as to keep the temperature nearly constant, and any deviations from a constant temperature were ascertained and noted, that the proper correction might be applied. The correction for the expansion of the air in the gauge, by a rise in its temperature during the progress of the experiments, was made according to the rules furnished by the rate of expansion of the gases, as determined by Gay Lussac, extended to compressed air by the experiments of Davy.* The correction for the changes of height of the mercurial column, within the range to which the temperature was suffered to increase, could not have been appreciable if acting entirely, and the counteracting effect of the expansion of the glass, further justified its being neglected. For similar reasons no reference was made to the effects of heat on the mercury in the cistern, *i*, on the cistern itself, and on the water within the pipe communicating with the boiler.

On the Thermometers.

In most of the researches of the committee, refinements in the mode of using the common thermometer would have been out of place. Results which might be obtained with little additional labour, and which would be interesting in both a practical and scientific point of view, were not to be neglected, and

* Let e represent the elastic force of the air within the gauge tube, expressed in inches of mercury; let h be the height of the mercurial column above the original zero; h', the height of the column above the new level; a, the height of the column of water in the steam pipe above the zero; s, the specific gravity of mercury; t, the tension of the steam within the boiler, in inches of mercury. Then $h'-h$ is the depression in the cistern caused by the rise of mercury in the gauge, and $a+h'-h$, the height of the column of water in the steam pipe above the new level in the cistern. We have then,

$$e + h + h' - h - \frac{a + h' - h}{s} = t$$

For the gauge in question, $h' - h = .01\ h$, $a = 17.5$ inches, also $s = 13.6$; then

$$e + 1.01\ h - \frac{17.5}{13.6} - \frac{.01\ h}{13.6} = t, \text{ or } e + 1.01\ h - 1.29 - .0007\ h = t;$$

the term $.0007\ h$ may be neglected as inconsiderable, since for $h = 24$ inches, this term is only .0163. The equation then stands,

$$e + 1.01\ h - 1.29 = t.$$

At the temperature of 48°, and at a mean pressure, the observed value of h was 3.23; of course, $e = 26.77$. The volume of the air in the gauge was 8.63.

To find the elasticity for any other height, h', find from the data relating to the volume of the air in the gauge, the new volume; call this v', and the elasticity due to it e'; then:—

$$v : 8.63 : : 26.77 : e'; \text{ and}$$
$$e' + 1.01\ h' - 1.29 = t.$$

To introduce the correction for temperature, since the elasticity produced by an increase of temperature corresponds with the expansion produced, and since the expansion of condensed air follows the same law as that of air of ordinary density, expanding $\frac{1}{490}$th of its bulk at 32°, for each additional degree of Fahr. above this point, or $\frac{1}{490}$th of its bulk at 48°; calling e'' the elastic force of the heated air, e' that of the same air at 48°, n being the number of degrees of heat above 48°.

$$e'' = e' + \frac{n\ e''}{490} = e'\ (1 + .002\ n)$$

whence, since $e' = \frac{8.63 \times 26.77}{v'}$,

$$\frac{231.02}{v'}\ .(1 + .002\ n) + 1.01\ h' - 1.29 = t.$$

to some of them great accuracy was essential. In the questions of the first class the thermometers were provided with wooden scales, and were graduated by immersion up to the point at which the scale commenced, the scale and upper part of the tube being exposed to the air; this was proper, as they were intended to be immersed in mercury nearly up to the scale. These instruments were examined after coming from the makers' hands, and the instrumental error ascertained. The tubes in which the thermometers were placed, and which contained mercury, were at first placed horizontally in one of the heads of the boiler; this had the advantage of rendering the tube for indicating the temperature of the water entirely independent of the steam, and thus any difference between the temperature of one and the other might be more effectually ascertained, than when the tube giving the temperature of the water passed through the steam. The position of these instruments interfered so much with other parts of the apparatus, and so much inconvenience and danger of error was experienced from the separation of the column of mercury in the thermometer, that these tubes were not used after the first weeks of experiment, and two vertical tubes, placed as already shown, were substituted for them.

The thermometers used, when the relation between the temperature of the steam and water, and the elasticity of the steam were to be observed in conjunction with some of the subjects more directly under the cognizance of the committee, had much pains bestowed upon them.

The scales (M and N, Plate 1,*) were metallic, and surrounded by glass tubes, fitting into a cup, a', through the bottom of which the stem of the thermometer passed water tight; a pipe, b' c', Plate 2, from the side of each cup, and provided with a stop-cock, d', regulated the flow of water through the enveloping tubes: a tight connexion above, with a reservoir, (O, Plates 1 and 3,) served, as in the case of the gauge, to supply the tubes with water. Small thermometers on the back of the scale of the large ones, showed the temperature of the water which surrounded them. The enveloping tubes being filled with water at 60°, the position of the boiling point of water and of the fusing point of tin, were used to verify the accuracy of graduation. The latter point, which is high upon the scale of the thermometer, having been very accurately determined, and being easily and with certainty ascertainable, serves as an excellent check upon the graduation. The greatest error within the limits just stated, was, in one instrument, three-fourths of a degree, and in the other one degree of Fahrenheit. The scales were graduated from two to two degrees, one quarter of a degree being readily estimated upon them. The corrections required by this examination were made through the medium of a table prepared for the purpose. In order to call the attention to the temperature of the water surrounding the scales, this temperature was recorded from time to time, when the height of the thermometers was observed. At no time did the rise of temperature, permitted in the water, make it necessary to apply a correction for the expansion of the scale.† None was required for the cooling effect of the water around the stem upon the mercury, owing to the method of verifying the scale.

The other parts of the apparatus, less general in their use, as the water gauge, safety valve, fusible plate apparatus, &c., will be more conveniently described in connexion with the experiments for which they were devised.

* In Plate 2, thermometer N, to render it conspicuous, is shown, as if the scale were turned to the front of the boiler.

† Upon the scale of one of these instruments there were 314° in 6 inches. Brass expands $\frac{1}{1\,1\,3}$ds of its length, from 32° to 212°. These 6 inches, at 32°, would become 6.0113 at 212°. Ten degrees upon the scale would become 9.99 by a variation of temperature from 32 to 212°, a diminution of only .01 of a degree for a variation of 180° in the temperature of the scale. In practice, the variation never exceeded thirty degrees.

SUBJECTS OF INVESTIGATION.

The queries originally proposed, together with the new matters, which were made the subjects of experiment, will be treated in the following order.

I. To ascertain whether, on relieving water heated to, or above, the boiling point from pressure, any commotion is produced in the fluid.

Including the examination of the efficacy of the common gauge-cocks, of the glass gauge, and of Ewbank's proposed gauge-cocks.

The investigation of the question whether the elasticity of steam within a boiler may be increased by the projection of foam upon the heated sides, more than it is diminished by the opening made.

II. To repeat the experiments of Klaproth on the conversion of water into steam by highly heated metal, and to make others, calculated to show whether, under any circumstances, intensely heated metal can produce, suddenly, great quantities of highly elastic steam.

First, The direct experiment in relation to the production of highly elastic steam in a boiler heated to a high temperature.

Not to interrupt the general train of investigation which follows a well known theory of explosions of steam boilers, the results of the experiments on the former part of this query, are inserted in another place.

III. To ascertain whether intensely heated and unsaturated steam can, by the projection of water into it, produce highly elastic vapour.

IV. When steam, surcharged with heat is produced in a boiler, and is in contact with water, does it remain surcharged, or change its density and temperature?

V. To test, by experiment, the efficacy of plates, &c., of fusible metal, as a means of preventing the undue heating of a boiler, or its contents.

1. Ordinary fusible plates and plugs.
2. Fusible metal, inclosed in tubes.
3. Tables of the fusing points of certain alloys.

VI. To repeat the experiments of Klaproth, &c.

1. Temperature of maximum vaporization for copper and iron under different circumstances.
2. The extension to practice, by the introduction of different quantities of water, under different circumstances of the metals.

VII. To determine, by actual experiment, whether any permanently elastic fluids are produced within a boiler when the metal becomes intensely heated.

VIII. To observe accurately the sort of bursting produced by a gradual increase of pressure, within cylinders of iron and copper.

IX. To repeat Perkins' experiment, and ascertain whether the repulsion stated by him to exist between the particles of intensely heated iron and steam be general, and to measure, if possible, the extent of this repulsion, with a view to determine the influence it may have on safety valves.

X. To ascertain whether cases may really occur when the safety valve, loaded with a certain weight, remains stationary, while the confined steam ac-

quires a higher elastic force than that which would, from calculation, appear necessary to overcome the weight on the valve.

XI. To ascertain by experiment the effect of deposits in boilers.

XII. Investigation of the relation of the temperature and pressure of steam, at ordinary working pressures.
Table from 1 to 10 atmospheres.

I. To ascertain, by direct experimemt, whether on relieving water heated to, or above, the boiling point, from pressure, any commotion is produced in the fluid.

The first experiments on the effect of relieving water in ebullition from pressure, were made in a glass boiler; here the fire was under the whole length of the boiler, which was a cylinder of fourteen and a quarter inches in length, and seven and a half inches in diameter. The steam within, being at a pressure of less than two atmospheres, by opening a cock at the end of the boiler, or the safety valve, also at the end, large bubbles were formed through the whole extent of the boiler.

The inquiry was prosecuted in the iron boiler already described, a distinct view of the interior being had through the glass windows placed in the heads. The greatest intensity of the fire was in front of the middle of the boiler, and extended through about one-third of its length: the part immediately near the flue, was next to this band in temperature. With this boiler experiments were made, which showed, that on making an opening in the boiler, even when the pressure did not exceed two atmospheres, a local foaming commenced at the point of escape, followed soon by a general foaming throughout the boiler, the more violent in proportion as the opening was increased. This small boiler was completely filled with foam by opening the safety valve, (nearly two-tenths of an inch in area) which was placed on the middle of the top, and the water violently discharged through the opening of the valve. The area of the valve bears to the horizontal section of the boiler, at the water line, the ratio of one to two thousand and fifty-five nearly.

The boiler was half full of water in these experiments. The gauge fell always on making the opening.

The foaming, which was so repeatedly observed, must be produced in a greater or less degree every time that steam is drawn from a boiler to supply the engine; every time that a gauge-cock is opened, or the safety valve raised. It is interesting in two points of view; first, in its effects upon the apparatus designed to show the level of the water within the boiler; second, by its throwing the water against the heated sides of the boiler.

Gauge-cocks and Glass Water-gauge.

The apparatus most commonly used in our country for determining the level of the water within a boiler, consists of three gauge-cocks attached to the boiler head, one of them being at the water level, and the others equally distant above and below that level.

These cocks in the experimental boiler, *a*, *b*, *c*, Plates 1 and 2, were 1.95 inches and 1.8 inches apart, measuring from the centre of the opening of the middle one, to the one above and to the one below.

The steam in the boiler being not higher than two atmospheres, the following experiment was made. The level of the water was reduced until it stood just below the lowest gauge-cock. On opening this cock, steam at first flowed out, then water and steam; on opening the second cock, in addition, water flowed freely from the lowest, which was above the hydrostatic level; the

foaming within the boiler, which was produced by thus relieving the pressure, was distinctly seen through the glass windows. On opening the third cock, steam and water issued from the second, which was two inches above the water level; and on partially raising the safety valve, water flowed freely from the second cock. A further rise of the valve filled the boiler with foam, water flowed freely out of the third cock, more than three inches and three-quarters above the water level, and finally through the opening of the safety valve itself. In these experiments, an opening of .03 of a square inch in area, the lowest cock, which, to the area of the water surface, was as one to thirteen thousand seven hundred, caused water and steam to issue through a cock, below which the water was known to be. A further opening of .03 of a square inch, making, with the first, .06 inch, or one six thousand eight hundred and fiftieth the area of the water surface, brought water from the lowest cock; a total opening of .09 inch, ($\frac{1}{1867}$th of the area of the water surface) brought water and steam from the middle cock, indicating that the level of the water was nearly two inches higher than it really was.

A first apparatus, which was contrived for applying fusible plates to the boiler, suddenly opened an aperture of .95ths of an inch in diameter. Even at low pressures, the scalding contents of the boiler were violently discharged, through this opening, against the roof of the experiment house.

It is time now to speak of the glass gauge-tube, as a means of indicating the level of the water within a boiler, in connexion with which an experiment bearing upon the performance of the gauge-cocks will be stated.

The form given to the water gauge, on its first trials, was that described to the committee by Mr. Hartshorne, of Cincinnati. This was a prismatic box of brass, of suitable dimensions; one face of which was supplied by a glass plate; this box, being put in communication with the boiler, by two pipes, one entering from the steam, the other from the water, the level of the water was seen through the glass plate. This apparatus was attached to the experimental boiler, and its indications compared with those of the gauge-cocks in the experiments already detailed. On relieving the water from pressure, the water within the gauge was agitated; during the further foaming its oscillations did not amount to half an inch, so that the hydrostatic level was truly shown by it; and further, on closing the openings, the fluid in the gauge became tranquil at the mean level of its oscillations, showing that it had fallen with the fall of the water within, caused by the escape of steam. An instructive experiment to the same purport was made on the occasion of a fracture in one of the glass windows, described as placed in the ends of the boiler. The account taken from the minutes of the day's experiments is as follows:

The temperature being at 292° F., and the pressure indicated by the gauge four atmospheres, the north window of the boiler, which had a flaw in it, cracked across the middle, and nearly horizontally; steam issued slowly through the crack; on looking into the boiler a foaming at the end where the steam was escaping was observed. The crack rapidly enlarging, the steam issued in quantities through it; the water was in general agitation throughout the boiler, running out at the crack, though its hydrostatic level was at the bottom of the window, about one inch and a quarter below the crack, and being distinctly seen at the opposite window, foaming near the top of the glass; the water-level gauge began to fall, oscillating not half an inch in its fall. The safety valve was now opened by hand, so as to waste the water with great rapidity. The water still issued through the crack, the water-level gauge falling. On closing the valve the water settled down, becoming comparatively tranquil; the water gauge remained at the same level: it had, therefore, indicated constantly the true level unaffected by the foaming, except in slight oscillations.

In fact, this gauge shows truly the height of the water within the boiler, until the foam rises so high as to pour over through the upper connecting tube.

The idea was suggested that by placing the gauge-cocks in a prism, connected above with the steam, and below with the water in the boiler, the true level of the water would be indicated. Such a cock was, therefore, applied to the box of the water gauge; its opening produced a local foaming in the gauge, which brought water through the cock, although the true level was much below it. The area of this cock was nearly equal to the area of that which opened into the steam chamber of the boiler.

In relation to the form of the water gauge, as already described, it does not seem to offer as many advantages as the tube which has been adapted to the boilers of some of the English locomotive engines.* The glass plate requires the support of horizontal bars, which are objectionable, or it must be reduced so much in breadth that the level is obscurely seen through it; the strain upon the plate being unequal, it is very liable to fracture; such fractures repeatedly took place near the centre of the plates in the gauge used by the committee.

To the use of the glass gauge for the high pressure engine, an objection occurs, from the effect produced by high steam upon the glass, apparently by its action on the alkali; by which the transparency of the glass is gradually destroyed. A similar effect was recorded by Cagniard de Latour, in his experiments on liquids at high temperatures, confined in glass tubes.† As far as the experiments of the committee have gone they show that green glass is not so readily injured; and as it is easily procured in tubes, a further reason appears for preferring the tube, in practice, to the plate.

An attempt which was made to substitute windows of mica in the boiler for those of glass, bears upon the use of that mineral for the plate of the water gauge; as does also another attempt which was made to protect the glass plates by a lamina of that mineral. The mica exfoliated under the action of the steam which insinuated itself between the laminæ through cracks which were invisible, if existing, before the experiment, or which may have been produced by the steam itself; the laminæ were separated, and thus the steam quickly found a more or less direct passage through the plate.

The tube gauge which was substituted for the prism is shown in Plates 1 and 2. $w\ x$ is the tube of green glass passing into the stuffing boxes, w' and x'; the stuffing enables an adjustment to be made for the unequal expansion of the glass and metal by heat, and prevents fracture on the subsequent cooling of the apparatus. y and z, Plate 1, are passages connecting the tube with the boiler; these have conical terminations, by which the pipe is readily attached to, and detached from, the tubes y and z, which are screwed into the boiler, and are provided with stop-cocks: coupling screws might, in practice, be substituted for these conical terminations. To protect the tube, $w\ x$, from currents of air, it was surrounded by a second tube, loosely applied. A scale was attached to $w\ x$, to indicate the level of the water within the boiler. The tube being transparent, shows the level of the water more readily than it can be seen in the prism before referred to, which was opaque on three of the vertical sides.

The gauge used was nine inches and three-quarters in length. The upper part being so near the top of the boiler as only to be affected by the foaming, in extreme cases; the lower part so near to the bottom that the level of the water was indicated, unless when very low indeed.

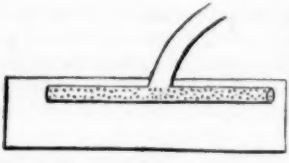
The position of the lower communication of the gauge with the boiler soon

* The application of such a gauge to a locomotive engine can give but little idea of its use for a stationary engine. The jarring in the locomotive must constantly expose the gauge to fracture, and perhaps may prevent its use. The glass water gauge has been adopted in at least one of the boats plying between New York and Amboy, New Jersey, belonging to Messrs. Stevens; and the committee understands, are also in use upon their locomotive engines.

† See also recent experiments on the action of water at high temperatures upon glass, by Professor Turner, of the University of London. Royal Society's Trans. for 1834.

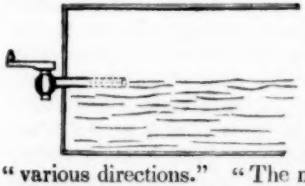
showed a defect, to which the instrument must be always more or less liable, namely, to the obstruction of the lower passage by sediment. To remedy this, a stop-cock was attached to the lower part of the gauge, as at x', Plate 1, and through it, when open, water could be blown, by the pressure of the steam in the boiler, so as to remove any obstruction. This method is to be preferred to that of closing the upper communication with the boiler, while the lower one remains open; in which case the sediment is driven up into the glass tube, soiling it, accumulating there, and affording only a temporary remedy. When the obstruction in the pipe is not removed on opening the cock, a wire inserted will effectually clear the passage.

In connexion with this subject the committee experimented upon the method proposed by Mr. Thomas Ewbank, of New York, for lessening or preventing the foaming here stated to occur. The remarks of Mr. Ewbank are to the following effect: "When steam is raised in a boiler, and the engine not work-"ing, the water within (if the flues are sufficiently covered) is probably on a "level and nearly at rest; but as soon as the steam is admitted into the cylinder, "it causes an ebullition of the water, which rises towards the mouth of the "steam pipe, in consequence of the portion of the pressure upon it being *suddenly* "removed at every stroke of the piston. This might, I think, be prevented by "continuing the steam pipe an inch or two into the boiler, and then branching "it off towards each end of it, with small apertures in its sides and ends, as in

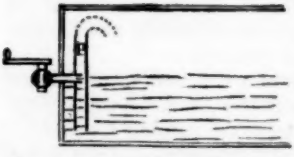


"the diagram. In this manner, the steam "would be equally withdrawn from every "part of a boiler, instead of being violently "agitated in rushing to one place. Such a "tube attached to the aperture of a *safety-*"*valve*, would be equally advantageous; or the "valve might be placed on one end of the "tube leading to the cylinder."*

"The inaccuracy of the common gauge-cock as a means of detecting the "true height of the water in a boiler, arises chiefly from two causes; firstly, "from the agitation of the water while steam is being withdrawn from the "boiler to supply the engine, or through the safety valve: and secondly, from "the current or rush of steam produced towards the aperture of a gauge-cock "when it is open; in consequence of which the water, though previously at "rest, is agitated and carried out through it.



"The last mentioned defect may be lessened "by a perforated tube (see the accompanying "figures,) attached to the end of the cock which "is within the boiler. Such a tube would pre-"vent the current from being concentrated to-"wards the aperture of the cock as the steam "would enter it through the small openings, in "various directions." "The next figure shows a method by which both the "defects to which I have alluded as affecting the gauge-cock, may be reme-



"died. The cock passes through the head of "the boiler in the usual way, and is then united "to a perpendicular pipe, open at both ends, and "about two or three inches in diameter. The "lower end of the pipe is four or five inches "below the surface of the water, and its upper "end is carried as far above the level as may "be convenient." "When this cock is opened no current can be formed in

* Journal of the Franklin Institute, vol. 9, p. 366, 1832, letter from Thos. Ewbank, Esq. of New York, to the Com. on Explosions.

"the direction of its aperture, and the water in the tube P (which will of course "be at the general level of the water in the boiler,) will not be so subject to "agitation*."

To test the idea that the foam which issues through the gauge-cock is produced by a rush of steam towards the aperture, and the method, proposed by Mr. Ewbank, for lessening it, tin pipes, ten inches and three-eighths in length, and three-eighths of an inch in diameter, with seventy-nine perforations, each about two hundredths of an inch in diameter, were attached to the central and lowest gauge-cocks *b* and *c*, Plate 1. When the level of the water within was about five-eighths of an inch below the cock *c*, or nearly two inches and four-tenths below the cock *b*, on opening the lowest cock, the steam being at a pressure of two atmospheres and two-tenths, a very little water mixed with the steam, passed through the opening of the cock; on opening the middle cock *b*, water and steam flowed through *c*; on closing this and opening the highest cock *a*, less water issued through *c*. When both *a* and *b* were opened, the water flowed copiously through *c*. At the close of this experiment, the glass water-gauge showed that the level of the water within the boiler was one inch below the lowest cock.

In another experiment the water being one inch and a half below the lowest cock; *c* being opened, no water issued; *c* and *b* being opened, a very little water issued through *c*; *a*, *b* and *c*, being opened, a little water was mixed with the steam.

The facts thus elicited, are in accordance with the preceding observations of the committee in relation to the general foaming which takes place when an aperture is made in any part of the boiler. The great respect which they entertain for the ingenious author of this device, on account of the valuable contributions which he has made to them, induced them to give this full trial of his suggestion.

The third form of apparatus would cut off the access of water from the general foaming, until it reached the level of the lowest apertures; but it would substitute a local foaming which would effectually, if not equally, prevent the true hydrostatic level from being indicated: in this respect it is nearly equivalent to the gauge-cock, already described, as applied to the water-gauge.

Alarm Floats.

The various floats which have been applied to show the level of the water within a boiler are well known. They have never obtained favour in this country, and are considered particularly objectionable in their application to the high pressure boiler, on account of the motion within. The stuffing-box, commonly used to pass the index-rod of the float through the top of the boiler, is objectionable, and different devices have been originated with a view to remedy this difficulty. That of Mr. Thomas Ewbank, of New York, described in volume 16, of the Journal of the Franklin Institute, is highly ingenious, and is reported by him to have stood the test of experience in his small boiler, producing steam of rather less than five atmospheres. The apparatus of the committee did not furnish facilities for a proper trial of this float; and besides, such a trial would be inadequate to test its use in practice.

A float serving to give an alarm by the issuing of steam, was made the subject of a few experiments, and answered well, as far as those trials went. Long use, however, could alone determine, perfectly, the peculiar liabilities to derangement in this apparatus. The float alluded to is shown on Plate 4, fig.

* Journal of the Franklin Institute, vol. 10, pp. 80, 81, 1832. "Supplement to the communication of Thomas Ewbank, Esq. of New York, to the Com. on Explosions."

A. The requisite buoyancy is given to the metallic pyramid, *a*, which is solid, by the weight *b*, acting as a counterpoise over the fulcrum *c*. The whole apparatus is attached to the top of the boiler by the screw *d*, and the nut *e*, and the working parts are thus entirely within the boiler. When the water is at the proper level *f g*, the shoulders *h* and *i* are in the same horizontal line, and the disks *k l*, which are pressed against the shoulders by two springs shown in the figure, close the apertures *k m*, and *l n*, which, when open, permit steam to escape from the boiler. Should the water sink below its proper level, the equilibrium of the pyramid *a*, being destroyed, the shoulder *i*, would press against the disk *l*, remove it from the aperture, and permit steam to escape through *l n;* should the water, on the contrary, rise above the proper level, steam would escape through *k m*. The force of the springs which close these openings, should, of course, be duly proportioned, as they will determine the sensibility of the apparatus. The details of construction are clearly shown in the figure, which is drawn to a scale.*

The quantity of steam which would escape by the small opening *l n*, while it would serve as an alarm, would not materially diminish the supply of water within the boiler. The float used by the committee, was found to be sensible to less than three-tenths of an inch in the change of level: it could have been made more sensitive by increasing the breadth between the shoulders, so as to bring them in contact with the disks, as shown in the figure.

Effect of Foaming on the Elasticity of the Steam within the Boiler.

This point was the next proposed for examination. When an opening is made in a boiler, of which the sides are heated, will the effect be to diminish the elasticity of the steam within, by permitting its escape, or will the water thrown upon the heated sides by the foaming which results, be converted so rapidly into steam as actually to increase the elasticity of the vapour within? It is obviously difficult to obtain an answer to a query involving so many conditions. It might be expected, however, that a small boiler would afford satisfactory means of making a fair trial of the question, since the size of the openings could be varied very easily, so as to make them comparatively small, or very great. The position of the boiler used by the committee in its furnace was such, that the sides could be very readily heated; thus placing it in favourable circumstances to increase the elasticity of the steam by producing a foaming within. The apparatus was therefore adapted to make the desired trial.

M. Arago, in his Essay on the Explosions of Steam-Boilers, states, that MM. Tabareau and Rey, at Lyons, found on opening a large stop-cock, connected with a small high pressure boiler, that the safety valve rose, showing an increase of pressure within. The boiler was placed naked upon a fire of charcoal, and the part not containing water was surrounded by flame. The experiments of MM. Arago and Dulong, at Paris, were attended with a contrary result, the opening of a safety valve being always accompanied by a diminution in the elasticity of the steam within. The circumstances, however, were not the same as those in the experiment of MM. Tabareau and Rey.

To repeat this experiment, a hot fire was made beneath the boiler, and when the water had fallen to about three inches above the lowest line of the cylinder, the experiment was commenced, the pressure being about three atmospheres and a half. A stop-cock of .03 sq. inches in area, $\frac{1}{10950}$th part of the area of the water surface at the beginning of the experiment, delivering per second, at three

* In the figure, the shoulders *h* and *i*, do not rise high enough; they should overlap the disks more, that no depression or elevation of the water may carry them clear of the disks.

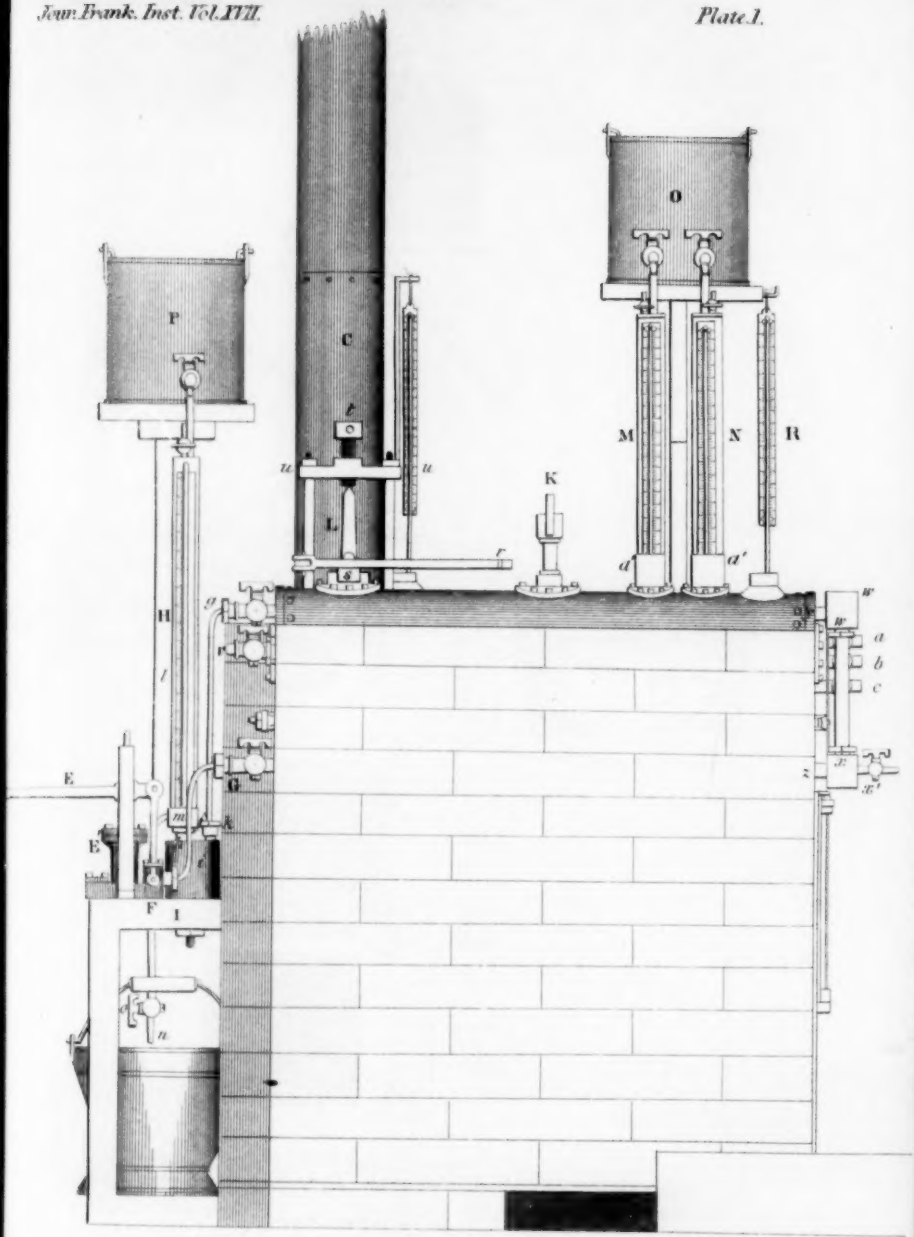
and a half atmospheres, about four hundred and nine cubic inches of steam was first opened; next the safety valve was raised, either in part or entirely, the area when entirely raised, being .208 sq. inches, or $\frac{1}{1030}$ths of the water surface, and capable of delivering, in one second, at three and a half atmospheres, a bulk of steam nearly nine times that of the steam chamber. The water level falling by the waste caused in the experiments, the steam soon became surcharged with heat; and the iron of the boiler, from near the water line to more than one-third of the distance from the lowest line to the middle of the convex surface, became, on each side of the water line, heated until it attained redness, passing, of course, through the temperature of maximum vaporization of the water thrown by the foaming, upon the iron. The experiments were made at intervals, until all the water was exhausted. Water was then injected in small quantities, and with the bottom of the boiler for the most part red hot, the trials were repeated.

It will be seen from the following table, that the result was uniformly a diminished elasticity of the steam within, as shown by the fall of the mercury in the steam gauge. The pressures varied, in the former part of the experiments, from three and a half to eight atmospheres.

The first column of the table contains remarks referring to the level of the water within the boiler. The second to the opening made. The third is the temperature indicated by the thermometer, M, Plate 1, before referred to, as passing nearly to the bottom of the boiler. The fourth, the height of the mercury gauge, before making the opening. The fifth, the height immediately after making the opening, unless the contrary is stated in the sixth column, which contains remarks relating to the effect on the gauge. The seventh column contains general remarks.

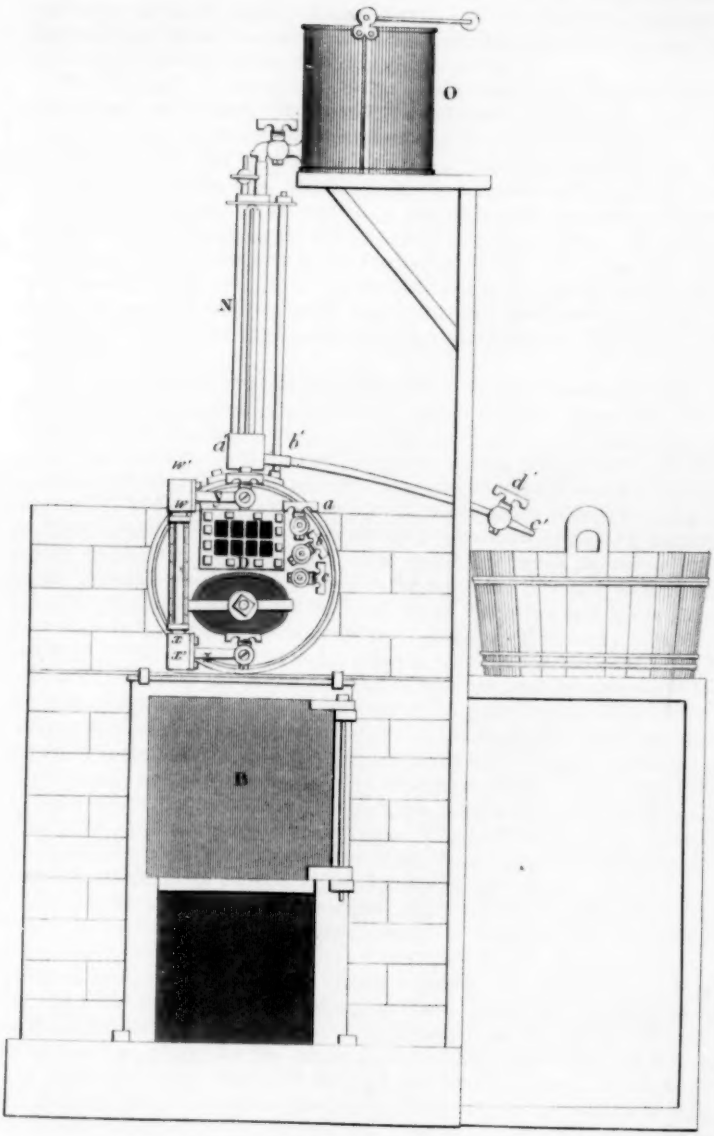
The thermometer at first indicated the temperature of the water, then that of the surcharged steam, and finally was affected by the heat radiated from the bottom of the boiler.

Remarks on Depth of Water.	Nature of Opening.	Temp. by long Ther.	Height of Steam Gauge.		Remarks on the Depression of the Steam Gauge.	General Remarks.
			Before.	After.		
		Fah.°	Inches.	Inches.		
3 inches,	Gauge-cock,	284½	18.6	18.0		Temperature of air in gauge, 80°.
	Do.		20.4	20.2		Pressure corresponding to 18.6 inches, 3½ atmospheres.
	Safety valve,		20.5	20.0	Fall very rapid.	
	Gauge-cock,		21.0	20.9	Fall immediate.	
	Safety valve,		21.3	21.0		Pressure corresponding to 21.3 inches, 5½ atmos.
.9 of an inch,	Gauge-cock,	317½	21.9	21.8		
	Safety valve,		22.1	21.7	Fall in ½ second.	
	Do.		22.6	20.6	Fall in 2 seconds.	From about 8⅛ to 5 atmospheres.
.9 inch nearly,	Stop-cock,	380			Falls.	Steam surcharg'd, bottom rapidly increasing in heat.
	Safety valve,	468½	15.1	12.6		
	Gauge-cock,		18.0	14.0		Water exhausted, supply thrown in.
	Safety valve,		16.0	14.0	Sudden descent.	Thermometer rose to 600°.



Scale 1 inch to the foot.

Engraved by J. Yeager.



Scale 1 inch to the foot.

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II. To repeat the experiments of Klaproth relating to the conversion of water into steam, by highly heated metal, and to make others calculated to show whether, under any circumstances, intensely heated metal can produce, suddenly, great quantities of highly elastic steam:—

The first part of this query relates to the repetition and extension of the experiments of Klaproth, the second has reference to them, but may be determined by direct experiment, independently of the methods required for obtaining an answer to the first part of the query. It has been supposed that because the metal of a boiler was heated above the temperature at which the metal would produce steam most rapidly, it was impossible to account for the production of quantities of highly elastic steam, by such a cause. The committee, determined to make the fact of the production of high steam by intensely heated metal the subject of a direct experiment, and under circumstances as nearly similar as possible to those which may occur in a boiler, of which some parts, as the sides or interior flues, may become unduly heated, when not in contact with water.

The experimental boiler being arranged as already described, a small quantity of water was placed in it and boiled away; the heat being still applied, the temperature of the bottom was gradually raised. At different temperatures of the bottom, water was thrown in by the forcing pump, and the effect of a given quantity, on the gauge, noted. The temperature of the steam generated, was ascertained by a thermometer passing horizontally through the back head *g*, Plate 1, and two-thirds of the diameter above the bottom of the boiler: a second horizontal thermometer as near to the bottom as the rim of the boiler would permit, served to show whether the heat was rising or falling, and was noted for this purpose. Both the windows of the boiler had glass $\frac{3}{8}$ths of an inch thick in them, without the cross bar covering. The water injected was at 70° Fah. The course of the water injected could be distinctly marked after the bottom of the boiler had become heated to redness, and was examined through the glass window *d*, Plate 3. The force of the pump carried it to the fire end, nearly; the boiler being slightly inclined to the back end, the water slid back in one or more dark masses, moving down the central line, or diverted up the sides, greatly agitated and frequently changing its shape. The water generally disappeared at the back end, though parts were retained by accidental spots of sediment, and disappeared upon them. The table below gives the results of the second day's experiments on this subject; they were terminated by violently bursting out the glass window at the fire end of the boiler.

The height of the lower thermometer, as noted by an observer at the back end of the boiler, is given in the first column of the table, with the appearance of the bottom of the boiler, both being examined before injecting water. The gauge was allowed to fall to the height denoting one atmosphere, before giving the number of strokes of the pump, from which the quantities of water, in the third column, are taken. The pressures in the fourth column were noted on the gauge by the same experimenter, who threw in the water. The first effect was examined through the back window, D, Plate 3, and the temperature of the steam produced, before the gauge began to fall, was noted as is recorded in the fifth column. As in all the experiments, the steam was rapidly produced, and the total effect was the object sought, the time was no further noticed than to ascertain that accidental circumstances independent of the temperature, rendered the total time of evaporation very variable, and that the maximum of effect was always passed in the space of from one to four or five minutes.

Temperature of thermometer near bottom.	Appearance of bottom of boiler.	Water injected in fluid ounces.	Pressure produced by injection. Atmospheres.	Temperature of Steam produced by injection.
306	Black.	2	3.3	336° F.
	Do.	Do.	3.4	340
330	Do.	Do.	3.3	356
	Red in part.	Do.	3.7	362
348	Red.	Do.	3.7	376
	Do.	3	4.2	
	Do.	5½	8.2	
384	Do.	5½	8.2	388
418	Do.	7½	8.7	424
428	Do.	10	9.8	448
448	Do.	Do.	12.0?	516

In the last experiment, the glass window at the fire end of the boiler, blew out with a quick sharp report, as loud as that of a musket; the fragments of glass, from a hole in the centre of the plate, were projected through a window, about three feet from the boiler, and could not be found. The number for twelve atmospheres is placed opposite to this experiment, as being an approximate result. In the act of observing the gauge, the glass burst, and the mercury at once fell: the number of inches at which the mercury had certainly risen, and above which it was, by an undetermined quantity, not, however, very considerable, was noted; and from this the pressure given in the table, is calculated. Here explosive steam was generated by the injection of water upon red hot iron, and in a time not exceeding one or two minutes at the most, the interval between the last stroke of the pump and the explosion, not having been sufficient to note the height of the gauge; the experimenter being at the pump, which was adjacent to the gauge.

By comparing the temperature of the steam in these experiments, with its observed pressure, it will be seen, that in not one of them was water enough injected to give the steam a density even approaching to that corresponding to its temperature: for example, 336°, F., should give a pressure of nearly 7¾ atmospheres, instead of 3.3, the observed pressure; 388° should give more than 14* atmospheres, instead of 8.2 and 448°; about 27½ atmospheres, instead of 10. The violence of the effect was not, therefore, carried as far as it might have been, the metal not having been cooled down as far as it might have been, to produce the greatest effect; and yet, within two minutes the pressure was changed from one to twelve atmospheres.

The rise of temperature shown in the first column, serves to prove, that by successive introductions of water, the metal was not so far deprived of heat as to be cooled towards the point of maximum vaporization, but that the results were obtained with metal heated to redness.

A similar experiment to these was made by our countryman, Perkins, but surcharged steam being present in the vessel into which heated water was

* Arago and Dulong.

forced, it was to the action of this that he attributed his result. This opinion will be examined subsequently, but the attributed source of action was present only in a very attenuated state, if at all, at the beginning of each experiment made by the committee.

The repetition, and extension, of the experiments of Klaproth, was one of the most laborious of the undertakings of the committee, and the results will be found in a future article of the report.

III. To ascertain whether intensely heated and unsaturated steam can, by the projection of water into it, produce highly elastic vapour.

The supposition that water, thrown into hot and unsaturated steam, is flashed into highly elastic vapour, forms the basis of the theory of the explosion of steam-boilers, of our countryman, Perkins; a theory which has been embraced by many; and which, though shown to be contrary to the deductions from the well established laws of heat, is not now without its advocates. It seemed to the committee interesting to appeal to direct experiment upon this point, and thus to ascertain whether any circumstances, not embraced in the general view of the theory, existed; or whether all the circumstances had been rightly estimated, and the conclusions drawn from the application of the general laws of heat would be confirmed. Being unwilling to incur any considerable expenditure in this branch of their inquiry, the experiments were rendered uncomfortable beyond any thing which occurred in their other researches. The means of producing the unsaturated steam were these: a row of bricks was removed from the top of the furnace, and near to the boiler, thus laying bare nearly half the convex surface of the latter (five inches from the top). By building on the sides of the top of the furnace, with bricks, loosely arranged, a space was formed for placing fuel, having the boiler for its bottom, and bounded by the bricks on its sides. A cap of sheet iron above, served to promote the draught and to carry off much of the deleterious gas produced by the charcoal used as fuel. The fusible plate apparatus was removed from the boiler, to prevent injury, and the safety valve was surrounded by a tin to keep the fuel from contact with the valve. By filling the boiler about half full of water, and applying heat below, to raise the water to any required temperature, the upper half of the boiler would be filled with steam of an elasticity due to that temperature, this elasticity being measured by the gauge. Fire being now placed upon the top would heat the metal of the upper half of the boiler; and this, by communicating its heat to the steam, would surcharge the latter. To measure the temperature, thus acquired by the steam, as well as that of the water below it, thermometers were placed in the iron tubes already described; the mercury was removed from the tubes, except enough to cover the bulbs of the thermometers, so that the temperature shown by them might be, as nearly as possible, that of the steam by which the shorter tube was surrounded, and of the water, into which the longer tube dipped. The scales of these instruments were protected from the fire, by surrounding them, at some distance, by tin plates. The scales were of seasoned box wood, the refinement of a correction for the errors of the instruments was not considered to be at all required by the nature of the research, the results of which errors, even a few degrees of temperature would not materially affect. In the final experiments, on this subject, the thermometers, with metallic scales, and surrounded by water, were put in place. The apparatus for injecting water, consisted of a tube attached to the stop-cock, *v*, Plate 1, on the back head of the boiler, and which communicated with the forcing pump; the tube terminated in a spherical segment, in which fourteen holes, each of the size of a cambric needle, were made; through these the water was forced in spray. By examination it appeared that the small stream, from the highest hole, struck the top of the boiler near the safety valve; that two or three struck the front head;

two or three the water in the boiler, near the back head, leaving from seven to nine apertures, the water from which crossed the steam chamber in an inclined and very effective direction. The effect of the streams from the three or four apertures, first spoken of, would be, if they were not taken up by the steam, to vitiate, in degree, the experiments, by striking the top and end of the boiler. With the openings, thus described, the first day's experiments on this subject were made. The heat of the surcharged steam could not, with the arrangements then provided, be raised above 484 degrees. The method of experimenting, having been the same as was subsequently used, may as well be stated in this place. The fire having been applied below the boiler, the water was heated to a temperature corresponding to from one and a half to two and a half atmospheres; the coals were then, in part, removed to the top of the boiler, fresh fuel being supplied below: the effect of the heat applied above was soon visible upon the thermometer in the steam, and upon the gauge. When the temperature of the surcharged steam sufficiently surpassed that of the water, as shown by the larger thermometer, the injection of water was commenced, the injection pipe being carefully kept cool by wet sponges and cloths. The temperature of the thermometers in the water and steam, were noticed both before and after the injection, by one experimenter, while a second made the requisite number of strokes of the forcing pump, observed the indications of the steam gauge, and when the experiment was concluded, gave the quantity of water used. The temperature of the air in the gauge was noted from time to time. The apertures in both the heads were secured with metallic plates, to prevent leakage through them.

On the second day, six of the fourteen small holes were plugged up, that the source of error, already mentioned, might not exist. The temperature attained by the surcharged steam was 440°, at, and below which, experiments mere made. The general nature of the results, obtained on the first and second days, coincide, allowing for the difference of circumstances, so entirely with those of the final trial, when a satisfactory temperature was obtained in the surcharged steam, that it would be uninteresting to detail them. The same remark may be made of subsequent trials.

As the quantity of water thrown in, during all these experiments, was small, it was considered advisable to increase it, in order that more marked effects might be obtained; this was done by removing the pierced head from the pipe, thus delivering nearly the full capacity of the pump at each stroke. The quantity of water thus injected through the steam by each stroke of the pump, was, at a mean, half a fluid ounce. No heating of the injection water was required, as the heat necessary to raise water from the temperature of the experiments to the boiling point was but a small fraction of that required to convert it into steam.

In the last day of trial the heat of the top of the boiler was so great and so long sustained, that the thermometer in the water became, in the course of the experiments, for reasons which will be stated, comparatively useless, as an indicator of the temperature of the water. The following tabular view of the results of the experiments is extracted from the minutes. The first column of the table contains the temperature of the surcharged steam, previous to the injection of water in any experiment, the second column that after the injection, this comparison being made to ascertain whether the heat supplied was, or was not, sufficient to make up for that consumed in vaporizing the water thrown in. The third column shows the quantity of water injected; the fourth the height of the gauge before the experiment; the fifth the height after the experiment; the sixth the temperature of the gauge; the seventh and eighth, the pressures in atmospheres, calculated from the height of the gauge, and the temperature of the air within it, before and after each experi-

ment. No notice is taken of the temperature of the scales of the thermometers, it having varied but 10° Fah. namely, from 86 to 96°.

The first experiment is introduced, to show the temperature of the water within the boiler, before the long continued heat had sensibly affected the indications of the thermometer.

Height of Thermometer in Steam.		Ounces of water injected.	Height of Gauge in inches.		Temperature of air.	Height of Gauge in Atmospheres.		REMARKS.
Before exp't.	After exp't.		Before exper't.	After exper't.		Before exp't.	After exp't.	
376		0	21.17		65	5.72		For comparison, no water injected. Water in the boiler, 318° Fah.
462	463	2	21.30	21.25	66	5.85	5.80	
506	509	3	21.50	21.50		6.15	6.15	Gauge stationary.
508	510	7	21.52	21.47		6.21	6.07	
518		0	21.80		70	6.65		Temperature of air in gauge noted between two experiments.
519	521	3	21.80			6.65		Gauge fell slightly, then rose to original level.
522	524	6½	21.80	21.70		6.65	6.48	
526		10	21.80	21.65		6.65	6.41	
528	528	13	21.80	21.60		6.65	6.34	
532		0	21.90			6.82		
533	533	6	21.90	21.85		6.82	6.74	Rose again immediately to 21.90.
533	533	14	21.90	21.70		6.82	6.48	Fell nearly .2 inch. *Note.* 533° is, according to the formula of Arago and Dulong, the temp. of saturated steam of more than *sixty atmos.*

At the close of these experiments, the metal was, in many places, but little short of a red heat, visible in daylight.

The precise state of things in a boiler, of which parts are unduly heated, was represented in these experiments; there was the surcharged steam, and heated metal ready to give up its heat to replace what might be absorbed in the conversion of the water injected, into steam. This latter circumstance renders the case different from that contemplated in the deductions of theory which have been brought to bear upon the question. The greater or less intensity of the heat afforded by the top and sides of the boiler would necessarily modify the effects observed, by the injection of any given quantity of water; this is observable in the numbers given in the table, where although the greater quantity of water injected does not fail in two consecutive experiments to show a greater depression of the gauge, yet in distant experiments the same is not the case. ***We see that in no case was an increase of elasticity produced by injecting water into hot and unsaturated steam, but the reverse, and in general that the greater the quantity of water thus introduced, the more considerable was the diminution in the elasticity of the steam.*** The quantity of water injected was from 3.5 to 24.3 cubic inches. The immediate rise of the gauge after each experiment, shows how rapidly heat was supplied by the sides of the boiler to the steam within.

That the steam was highly surcharged with heat, appears by comparing the pressures corresponding to the temperatures, with those given by Dulong

and Arago, for saturated steam. For example, the pressure shown by the gauge when the steam was at 506° Fah. was 6.15 atmospheres, while the table just referred to gives for this temperature a pressure of *forty-eight atmospheres.* The temperature was carried to 533° Fah. when the pressure shown by the gauge was 6.82 atmospheres, while saturated steam at that temperature would have had a pressure of more than *sixty atmospheres.*

In order to ascertain whether the thermometer relied upon to give the temperature of the steam was affected, if at all, in excess or defect by the conducting power of the metal; the temperature of the boiler just beyond the tubes was taken, as nearly as was practicable, by a thermometer, R, Plate 1, dipping into a clay receptacle, upon the top of the boiler. This thermometer did not rise above 405° Fah.; its distance from this source of heat was ten inches, and that of the iron tube inclosing the thermometer, six and a half inches. Supposing the temperature stationary on top, the temperature of the metal of the top of the boiler near the tube of the thermometer would have been 479°,* showing that it tended to carry off heat from the thermometer, which, if at all affected by the metal above it, showed too low a temperature for the steam in contact with it. The temperature of the source of heat would have been from these data, 582° at the extreme end of the part covered with fuel, which was of course at a lower temperature than the middle portion.

On examining the apparatus after the conclusion of the last day's experiments, it was found that some of the putty used in tightening the lower joint of the thermometer in the water, had been softened by the heat, and had flowed into the tube, thus affording a direct communication between the steam and the bulb of this thermometer: this circumstance accounts for the instrument being affected in this day's experiments and not in the preceding ones.

* If we suppose the heat of a small bar of metal, cut from the top of the boiler, to have been derived by the conducting power of the metal alone, the heating effect of the steam within being neglected, and further, that the temperatures of the bar had become constant, then the ratio of the excess of the temperature (y) of any point at a distance (x) above the temperature of the air, to that (y') of any point at a distance, (x',) is given by the proportion,

$$y' : y :: \text{Log. } x : \text{Log. } x'.$$

In the case before us, $y = 405 - 80 = 325°$, $x = 10.0$ inches, and $x' = 6.5$ inches, whence $y' = 399°$, and the temperature at that point is $y' + 80 = 479°$.

To find the temperature of the source of heat, we have the equations—

$$y' = A\, e^{-x' \sqrt{\frac{2h}{kl}}} \qquad \text{and } y = A\, e^{-x \sqrt{\frac{2h}{kl}}}$$

in which y' and y are the excesses of the temperatures at the distances x' and x over that of the air. A is the temperature of the source, e the base of the Naperian logarithms, $2l$ the thickness of the bar, and $\frac{h}{k}$ the ratio of its radiating to its conducting power. To find $\sqrt{\frac{2h}{kl}}$, which is the same for the two points x and x'; we have

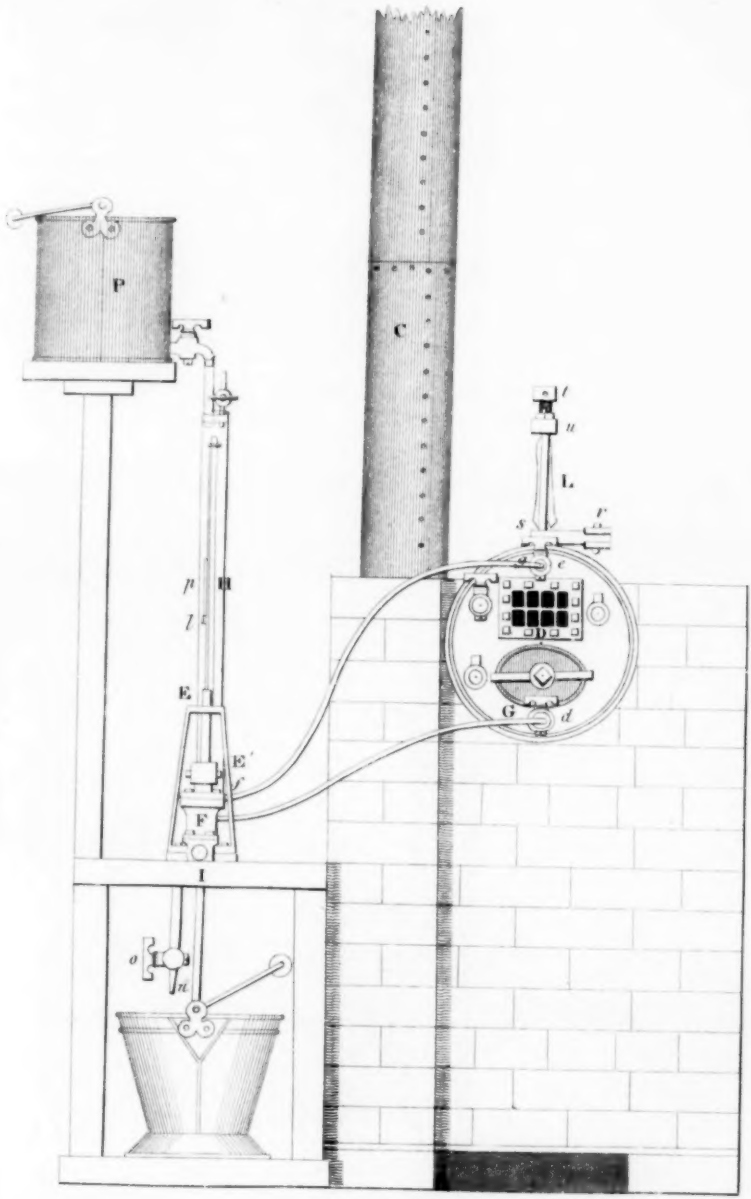
$$\frac{y'}{e^{-x' \sqrt{\frac{2h}{kl}}}} = \frac{y}{e^{-x \sqrt{\frac{2h}{kl}}}}, \text{ whence Nap. log. } y' + x' \sqrt{\frac{2h}{kl}} = \text{Nap. log. } y + x \sqrt{\frac{2h}{kl}}, \text{ and}$$

$$\sqrt{\frac{2h}{kl}} = \frac{\text{Nap log. } y' - \text{Nap. log. } y}{x - x'}$$

in the case before us, $\sqrt{\frac{2h}{kl}} = .058$ and log. A = log. $y' + x' \sqrt{\frac{2h}{kl}}$. log. $e = 2.765$, and therefore $A = 582°$.

The boiler must have been hotter at the furthest point than it would have been if not in contact with the surcharged steam.

(*To be continued.*)



Scale 1 inch to the foot.

Engraved by J. Yeager.

Plate A.

Fig A.

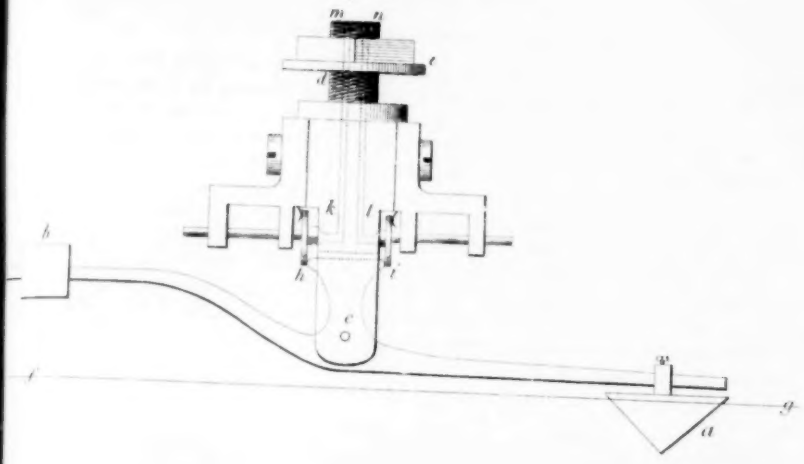
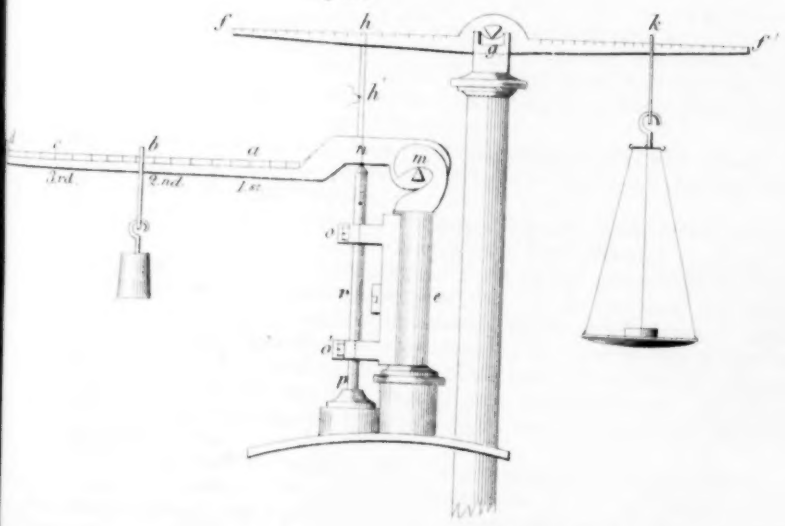


Fig. B.



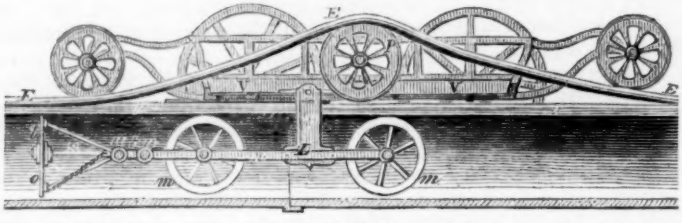
Engraved by J. Yeager

Pneumatic Railway.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

A very warm controversy has been carried on in the pages of the London Mechanics' Magazine, in relation to the pneumatic railway recently patented by our countryman, Mr. Pinkus, now a resident of London. To give the readers of this journal an idea of the nature of this patent, a cut is subjoined, representing a section of the tunnel forming the railway, and showing the carriage to be propelled in its connexion with the tunnel.

The method of propulsion is by rarifying the air in the conduit pipe in front of the shield *o*, which is supposed to move air tight. The pressure of the air behind the shield will then urge it forward. This shield, or as Mr. Pinkus terms it, "dynamic traveller." is connected with guide wheels *mm*, which keep the bar S L in the axis of the tube. To this bar is connected an upright arm, *p*, passing through a slit in the upper side of the pipe or tunnel, and intended to transmit the motion of the *shield*, *l o*, to the car, V V. The slit thus required in the upper side of the tunnel is closed by a



"square cord," shown in the figure, E E E, passing over one and under two wheels; the middle wheel lifting the rope as the carriage, V V, proceeds, and the front wheel guiding it to its place upon a groove made to receive it, and thus closing the slit. The car, V V, or "governor," as it is termed in the specification of the patent, moves upon two rails, attached one to each side of the tunnel, and parallel to its axis.

Mr. Pinkus claims, as new, these various arrangements, with minor ones not described, and disclaims, as old, the use of the tunnel as a means of transport for goods, &c. in its interior.

The prospectus of "a National Pneumatic Railway Association" was accompanied by the opinions of Dr. Lardner and Prof. Faraday in regard to this means of locomotion. The opinion of the former gentleman was decidedly favourable. The practicability of the scheme he does not doubt. Considers it a frictionless mode of transferring power to a distance. Calculates the necessary rarifaction to be produced in the tube or tunnel, and the power obtained. The relative economy of this new, and of the *old* rail way. The diminution of accidents to cars, and upon inclined planes. Examines the difficulties of keeping the tunnel air tight, and concludes that they are not insurmountable.

Mr. Faraday modestly remarks, that he possesses no *practical* experience in regard to railways, but approves, in general, of the principles of the pneumatic railway, and enumerates some advantages which will accrue from its substitution for those of the ordinary kind.

The editor of the Mechanics' Magazine, notwithstanding the weight of authority thus against him, contends, that both in theory and practice, this

project is to be condemned, and quotes the experiments of Papin and others to show that air is not to be passed through tubes without friction. He refers, also, to the unsuccessful attempts of Valance to press air through a tunnel. These and other experiments to the same purport, the reader will find in vol. ix. of this Journal. A committee of the Institute reported upon a plan identical in *principle* with that of Mr. Pinkus, and the table drawn from the best experiments on the resistance of air to motion through tubes, shows how much power would be consumed in producing a given effect in a tunnel of a given length.

Here the view is taken, that the operation of drawing the air *out* of a tube, is of the same nature with that of forcing it in.

But on the contrary, Mr. Pinkus, in a reply to the editor of the Mechanics' Magazine, states that Mr. Hague has succeeded in applying the principle of Papin to communicate power to the distance of even seven miles, and that in one of his works, the power of a seventy horse steam engine is transmitted undiminished, and instantaneously, through a tube three miles in length. He further states, that the gas for lighting Birmingham is brought seven miles through pipes, with but a small diminution of force. Of the apparatus of Mr. Hague we have heard for the first time, but must remark that the latter fact is in contradiction to all the experiments hitherto made on the passage of gas.

The readers of this Journal would probably not be interested in the personalities of the articles in relation to this subject, and they have before them the means of forming a correct conclusion as to the merits of the pneumatic railway.

As one of the readers, I cannot approve of the scheme either in theory or practice. Not in theory, because of the consumption of power required to rarify the air in a long tube. Not in practice, from the primary difficulty of the long, uniform cylinders or tunnels required for the motion of the piston; and the secondary one, of the improbability of an air tight joint resulting from the "square cord" and groove. B.

Query in relation to the appropriate colour for the covering of the pipes of Condensers used in the manufacture of Gas.

TO THE COMMITTEE ON PUBLICATIONS.

Gentlemen,—Allow me to request from any one of your correspondents a reason why the pipes used for condensers at the Philadelphia Gas Works, are painted white. I understand their object to be to expose the gas as it comes from the retorts to the cooling action of the air. If so, the metal should be covered with some dark coloured paint, which, radiating better than the white, will keep the metal cool, and thus more effectually cool the gas. I take it for granted that the iron of the pipes forming the condenser must be coated to keep it from the effects of the weather, and if I am *right* in regard to the philosophy of the matter, the engineer is *wrong*.

Yours, &c. K.

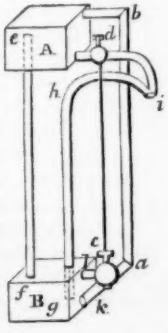
Substitute for a Waste Cock to Hydrants. *By* Robert Cornelius.

It is well known, that to prevent the freezing of water contained in the pipes of our hydrants, a waste cock has been applied to the lower part of the pipe through which water is drawn. This cock is opened by the same

operation which closes the escape pipe. The water from the escape pipe issues out, therefore, and passes into the ground.

Newton's patent hydrant conveys the waste water to a box, and remedies the inconvenience occurring from the process just alluded to.

The invention of Mr. Cornelius is to effect the same object. His arrangements, as explained at the last conversation meeting of the Institute, will be understood by referring to the annexed diagram. The parts are not there disposed as they will be in practice; the apparatus would want compactness in this form: they are displayed for the sake of explanation.



The box, A, is connected with the top of the hydrant, and B is placed below the ground so far as to prevent the water in it from freezing. The pipe, *a b*, is connected, near *a*, with the branch pipe, *k*, from the main water pipes, and at *b*, with the upper part of the box, A. The stop cock, *c*, opens or closes at pleasure the end, *a*, of the pipe, *a b*. This cock has two passages, one opening from *k* to *a b*, the other, through *l* to B. When one of these is open the other is closed, and vice versa. It is connected by the rod, *c d*, with the cock, *d*. When water is to be drawn, these cocks are brought into the position shown in the figure, when *c* is open and *d* closed; the water flows through *c*, and rises into the tube, *a b*, filling the box, A. The stop cock, *d*, being closed, the air from A passes by the tube, *e f*, into B, and escapes through *g h* at *i*. When the water has risen above the mouth, *e*, of the tube, *e f*, *e* being near the top of the box, A, it flows through *e f* into B. At first the compressed air in B finds a vent through *g h*, but soon the water rising above *g*, seals the pipe, *g h*, and the air is compressed in the upper part of B, until the elastic force is equal to that which the head of water can produce. The water in B meanwhile rises in *g h*, and at length escapes at *i*. When the hydrant is to be stopped, the cock, *d*, is turned. The same turn which opens *d*, closes the passage from *k* through *c* to *a b*, and opens that betwen *a b* and B. The cock, *d*, being open, the water from the box, A, flows out at *i*. The air in B passes through the pipes, *a b* and *e f*, into A, and the water which is in *g h*, and with any which may not be carried by the air through *a b*, descends into the box, B. The dimensions of the boxes, A and B, being duly regulated, and the pipes, *h g* and *e f*, properly placed, this hydrant will be very efficacious.

The quantity of water contained in the upper box, A, must flow from the hydrant after the stop cock, *d*, has been turned.

Civil Engineering.

Report, to the President and Directors of the Sandy and Beaver Canal Co., By E. H. Gill, *Civil Engineer, and Chief Engineer of the Sandy and Beaver Canal.*

Gentlemen,—In compliance with your request, I have the honour to lay before you the following report of the present state of the work under my direction:—

During the past summer the whole line has been minutely traced, with a view to a permanent location: by this survey the total extent of canal has

been reduced three miles, or the distance from the Ohio river at the mouth of Little Beaver creek to the western termination at the Ohio canal, by the recent examination and location will not exceed seventy three and a half miles.

The Eastern division of the canal, extending from the Ohio river to a point two miles west of New Lisbon, embraces a distance of about twenty-seven miles, of which seventeen miles are "slackwater:" for this description of improvement the stream is exceedingly well adapted, the valley being narrow and the banks bold and prominent, affording numerous and eligible sites for the locks and dams, and an abundance of good materials for their formation.

The summit or middle division is about fourteen and a half miles in extent, and the Western division, terminating at the Ohio canal, about thirty-two miles. The latter division extends through a country affording the greatest facilities for constructing a cheap and permanent improvement; the valley of the creek is broad and has nearly a uniform declivity from its source to its confluence with the Tuscarawas. On the Eastern division the lockage is four hundred and sixty-four feet, and on the Western two hundred and five, constituting in all six hundred and sixty-nine feet. In locating the Western division, the level has been kept up from Williams' mill dam to the debouch into the Ohio canal at the flourishing town of Bolivar, by which arrangement an excellent water power is secured to the Company, affording a head and fall of twenty-six feet: the owners of the property at the site selected for using the water have liberally ceded to the Company ten acres of very valuable land for that purpose. Sandy Creek at that point will yield a sufficiency of water, independent of the requisite supply for the canal, *at all times to work* twenty, and for eight months in the year fifty *pairs of mill stones.* This power may reasonably be estimated as worth $6000 per annum. Many other valuable sites for hydraulic purposes have been created or purchased along the route, which, in conjunction with the one above mentioned, will probably afford the Company a revenue of $7000 per year.

On the Eastern division of the line, forty-nine sections, or twenty-four and a half miles of canal, thirteen dams, and forty-six locks, are now under contract: on the Middle division, twenty-one sections or eleven miles, including the tunnels and the reservoir mounds on the west fork of Little Beaver Creek and Cold Run: and on the Western division twenty-eight sections or fourteen miles, eleven locks, one dam, and the aqueduct over the Tuscarawas river, constituting in all forty-nine and a half miles of canal, fourteen dams, fifty-seven locks, one aqueduct, and two reservoir mounds now under contract.

The work has been prosecuted in most cases with energy, and is now in a greater state of forwardness than could reasonably have been anticipated, considering that the season was far advanced when it was commenced. About thirty-four sections or seventeen miles of canal are now completed, and likewise the mason work of two locks, and 144,000 cubic yards of excavation removed from the summit deep cuts: dam No. 2, on the Western division, will probably be completed next week.

The foundations of five other locks and two dams are laid, and 1500 perches of wall built; and a large quantity of stones and other materials for the construction of locks and dams is prepared and on the ground; and I have no doubt all the work now under contract, excepting the tunnels and aqueduct, will be finished in the approaching year.

The work placed under contract is in most instances in the hands of responsible and efficient men, and has been taken on terms exceedingly favourable to the Company. There is at the present period on the line a force equivalent to 2160 men. The cost of the locks, which are built in the most durable manner of cut sandstone, will not exceed $700 per foot lift, being about thirty per cent. below the ordinary cost elsewhere. The cost of the dams, which are in most instances fourteen feet high, will average about twenty-eight dollars per linear foot across the stream; and the canal, exclusive of locks and dams, generally from $3000 to $5000 per mile.

A contract has been entered into for furnishing the remainder of the hydraulic cement; it is found in abundance contiguous to the line; the quality is equal to any I have seen, and the cost extremely moderate.

The contract for excavating the tunnel and approaches, has been taken by energetic and persevering contractors on reasonable terms, the former not exceeding the estimated cost: this work is to be completed by May 1837. As much has been stated in relation to the adequacy of the supply of water on the summit, it may be proper to remark, that during the past season I commenced and have continued a series of minute examinations of the most prominent streams relied on for a supply: those examinations have thus far fully corroborated the truth of the statements and calculations embraced in the report made to you last autumn by Mr. Hage and myself. I feel fully satisfied, that with the aid of the reservoirs that can be constructed on the summit, at a moderate cost compared with their utility, a much larger quantity of water may be introduced into the summit and its dependent levels, than will be requisite for the transit of the immense trade that is destined to seek a market through its channel. The reservoirs now under contract will contain as follows: West Fork reservoir, 130,000,000 of cubic feet; area 350 acres: Cold Run reservoir, 88,000,000 of cubic feet; area, 250 acres: in addition to which it is proposed to elevate the banks of the canal so as to retain one foot in depth of available water, and flood several pieces of low ground on its northern or upper side, amounting in all to about 150 acres, which, when full, will furnish about 6,500,000 of cubic feet, making in the aggregate from these sources alone, an available supply of 224,500,000 cubic feet of water, a demand on which *may* be requisite in a dry season for a period of 100 days. By calculation it will be perceived, that these reservoirs will afford for that period 2,245,000 cubic feet of water per day, equivalent to a discharge of 1559 cubic feet per minute. If to this sum is added the minimum natural flow of water on the summit as reported to you last autumn, (558 cubic feet per minute) it will be observed that the flow of available water in a dry period will amount to 2117 cubic feet per minute, or sufficient, after deducting all that the nature of the soil and climate will require for leakage, filtration and evaporation, for the passage of 185 *boats per day.* The West Fork and Cold Run reservoirs are about one mile apart: when filled, the surface of the water in each will occupy the same plane, or be elevated to the same height: it is designed to have a feeder extending from one to the other, so that the surplus water in one can be admitted into the other, if required. A large waste weir is to be constructed on this feeder for the purpose of discharging the waste water when both reservoirs are full. This water, when thus discharged, is conducted into the reservoir on the summit level. The first two mentioned reservoirs will receive the drainage of twenty-four square miles of country; the summit, *the drainage of eighty square miles.* The usual depth of rain that falls in this section of country can, I am informed,

with safety be premised at thirty-six inches per annum, or equal to a column of that height, being 83,635,000 cubic feet on a square mile, and on twenty-four square miles 2,107,244,800 cubic feet annually. From experiments made on a large scale elsewhere, for practical purposes, it has been ascertained conclusively, that seventy-five per cent. of the rain that falls can be laid up in reservoirs. From this data it will be observed, that the three reservoirs above alluded to may be filled seven times per year. This exhibit will probably satisfy the most sceptical as to the adequacy of the supply of water. As to the immensity of the trade that will wend its way through the Sandy and Beaver canal to an Eastern market, I believe there has never been surmised a doubt: a glance at the map will prove conclusively that a very large portion of the produce of Michigan, Illinois, Indiana, Kentucky and Ohio, which are rapidly increasing in population and wealth, must be wafted through it. The business of that section of country is now to a great extent accommodated by the New York improvements, but the completion of the Sandy and Beaver canal will secure to it a safer transit to and from the seaboard, much shorter, and *navigable six weeks earlier in the spring and three later in the fall* than the one now traversed; being sufficient inducements to secure it. What the extent of that trade will be, time alone can develope. On the Erie and Champlain canals, a very large portion of the business done on the first of which is derived from the country above mentioned, there have been received in tolls in 1829 $759,055, 1830 $1,032,476, 1831 $1,194,610, 1832 $1,196,008, 1833 $1,324,521, 1834 $1,292,956, and there is no doubt that the business of this year will greatly exceed the last. On the Ohio canal there was collected in 1832 $82,867, 1833 $136,920, 1834, $151,287, and the amount of tolls received the present year at some of the collectors' offices exhibits an increase of forty-five per cent. over the last.

When the canal or rail-road authorized by an act of the legislature of this State at their last session, to be constructed from the western termination of the Sandy and Beaver canal to the Miami canal, near the mouth of the Auglaise river, shall have been completed, it must add an immense revenue to your work, as it, in connection with the Wabash and Erie canal through Indiana, and the contemplated rail-road through Illinois to the Mississippi river, will constitute a continuous chain of internal improvement, extending westerly from the Sandy and Beaver canal 500 miles, and from Philadelphia 1000, into the rich and fertile regions of the west.

The following synopsis of the distance the trade of the country situated west and south-west of the Sandy and Beaver canal would have to travel from the western termination of that work, in order to reach a market by the various routes now or about to be, afforded it, will fully justify the conclusion that it must seek a passage through it.

Distance by the Ohio Canal, Lake Erie, New York Canal and Hudson River to New York.

From the Sandy and Beaver canal to Cleveland	80	miles.
From Cleveland to Buffalo . . .	200	"
From Buffalo to New York . . .	515	"
		"
Total	795	"

Distance by the Ohio and Mahoning Canals and Pennsylvania Rail Road to Philadelphia.

From Bolivar to Akron	42	miles.
From Akron to Beavertown	114	"
From Beavertown to Pittsburg	28	"
From Pittsburg to Philadelphia	394	"
Total	578	miles.

Distance by the Sandy and Beaver Canal and Pennsylvania Improvements to Philadelphia.

From Bolivar to Beavertown	87½	miles.
From Beavertown to Pittsburg	28	"
From Pittsburg to Philadelphia	394	"
Total	509½	miles.

From the rapid increase in business on the New York and Ohio canals, it is to be presumed that when the Sandy and Beaver canal shall have been finished, the tolls on the Ohio canal will amount at least to $400,000 per annum; and from the foregoing facts and statements it is to be inferred, that two-thirds of that trade will pass through the Sandy and Beaver canal, which would nett the holders of stock in that work, at the rate charged on the Ohio canal, an income of at least $60,000 the first season.* If to this sum is added the amount that may be anticipated from the liberal grant contained in the amended charter,† which cannot fall short of $150,000, the Company will receive, in the first year after the work is finished, $210,000 in tolls—independent of the large business that may be expected from the country west and north-west of the termination of their work—presenting the novel result of a canal yielding seventeen per cent. on its entire cost the first year after its completion.

All of which is respectfully submitted.

E. H. GILL, Chief Engineer *S. and B. Canal Co.*

New Lisbon, Ohio, Nov. 11, 1835.

Physical Science.

Of the Tidal Motions of Conductors, free to move. *By* Jno. W. Draper, *Christiansville, Mecklenburg, Va.*

1. "‡Dans d'autres circonstances on observe encore au milieu des masses liquides, des mouvemens singuliers qu'il est excessivement difficile

* The estimate may seem large, but it must be kept in mind that the Sandy and Beaver canal will constitute a connecting link between two large and important works, (the Ohio and Pennsylvania canal improvements) now completed; consequently it has not, like other canals, to await the growth of business.

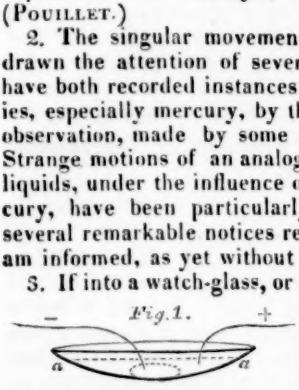
† The amended charter secures to the Sandy and Beaver Canal Co. all the tolls collected on the Ohio canal from boats that have passed through the Sandy and Beaver canal for seven years after its completion.

‡ In other cases there occur in liquids, singular motions which are so numerous and changeable as to be very difficult to describe. I shall attempt to give some notion of them, remarking, however, that notwithstanding the many experiments which I have made on the subject, I have not been able to determine any general law respecting them.

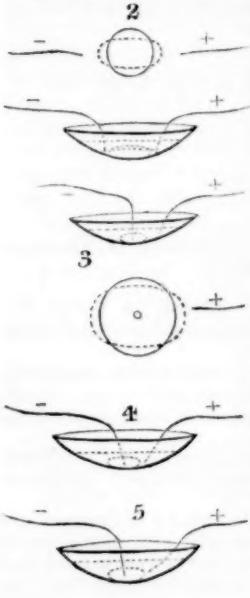
de décrire, tant ils sort nombreux et changeans. Je vais essayer d'en donner une idée, en remarquant toutefois, qu'après avoir fait de nombreuses expériences sur ce sujet, il m'a été inpossible d'en saisir la loi."—(POUILLET.)

2. The singular movements here spoken of by Pouillet, have likewise drawn the attention of several other philosophers. Erman and Serullas have both recorded instances of gyratory motion, produced in certain bodies, especially mercury, by the contact of others. There is also a similar observation, made by some of the earlier chemists, respecting camphor. Strange motions of an analogous description, are also observed in some liquids, under the influence of a voltaic current; these, in the case of mercury, have been particularly studied by Sir J. Herschel, who obtained several remarkable notices respecting them; they are, however, so far as I am informed, as yet without explanation.

3. If into a watch-glass, or shallow capsule, as *a*, *a*, fifty or sixty grains of mercury is poured, and over that as much water acidulated with sulphuric acid, as is sufficient to cover the surface of the mercury, and the positive and negative wires of a battery of twenty or thirty plates, arranged as indicated in figure 1, the mercury being in contact with the negative pole, and the positive pole being plunged into the water, at a short distance from it, currents are produced, both in the water and in the mercury. Supposing the power of the battery sufficient, the same effect takes place on removing the negative wire out of the mercury, into the water; but if the positive wire is in contact with the mercury, and the negative with the water, there is no motion at all, or at most, the mercury only curls itself up, into an elongated figure.

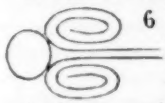


4. This motion varies according to several circumstances, but chiefly the position of the two wires. 1st. If the wires be as in figure 2, or on opposite sides of the mercury, the metal instantaneously elongates as shown by the dots, and currents also are seen playing in the water. 2nd. If the negative wire be introduced into the centre of the metallic globule, and the positive wire be brought on one side, as in figure 3, the mercury will bulge out *elliptically*, at both sides, nearest and furthest from the positive pole —and by regulating the force of the battery, either by changing the number of the plates, or altering the strength of the solution acting on them, the experiment may be so managed, that no motion shall ensue in the mercury, after this elliptical bulging is effected; but now, if the negative wire is cautiously raised from its position, so as to be just out of contact with the surface of the metal, as in figure 4, the mercury is immediately convulsed, and its whole surface covered with a kind of circular waves. On lowering the negative wire to its former position, and advancing the positive, as in figure 5, the moment it comes to the edge of the mercurial ellipsoid, the most intense convulsions are produced, which increase



until contact of the mercury and wire is obtained. 3rd. If the two wires form a kind of triangle with the globule, it turns upon itself.

5. At the same time that these movements are going on in the mercury, the surface of the water is ploughed by gentle currents, exactly resembling those produced by a breath from a blowpipe, directed slantingly across the surface, as in figure 6.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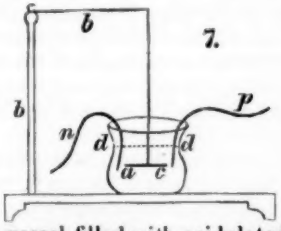
6. In proceeding to give an explanation of these motions, I shall not follow the analytical course of experiment, used in my researches, but commence with those principles, on which a true explanation is founded.

7. It has long been known, that the elements of compound substances, were held together in virtue of an affinity among themselves. Sir H. Davy, Berzelius, and other chemists, were led to suspect that this was due to the electric condition of those elements, and pursuing this hypothesis in its details, several brilliant discoveries were made, which ultimately changed the face of the science. Apart, however, from all hypothetical reasoning, it was found, that the poles of a voltaic battery had the power of influencing the atomic constitution of bodies, so as to be able to hold all chemical combination under control. This remarkable effect was imputed to the electrical attraction and repulsion of the battery—but a battery which is competent to the rapid decomposition of water, and even the reduction of potash, is found to give exceedingly faint traces of any electro-dynamic effect, being unable to cause the divergence of a delicate gold leaf electrometer, or affect the indications of a torsion balance. In the course of certain experiments, I had occasion to notice, that this effect, as to intensity, is entirely regulated by the medium in which the experiment is made; as for instance, a thin lamina of air, or gaseous matter, is nearly a perfect non-conductor to electricity of low intensity, but an expansion of water offers no such resistance. I hoped, therefore, that though I might not be able to exhibit the attraction of a polar wire for a suspended needle in the Coulomb balance, such an effect might ensue, if the experiment was made with the apparatus plunged in another atmosphere, whose conducting power differed from that in which we live. For the conducting power of a medium has no relation either to its cohesion or its chemical properties, and it did not appear improbable, that one might be found, which, though it should not interfere with the freedom of motion of a wire plunged in it, its conducting power, in relation to electricities of very low intensity, might exhibit those effects in a more elevated point of view.

8. To illustrate this reasoning, I took a platina wire, *a*, *c*, figure 7, two inches in length, and suspended it by a raw silk thread from a stand *b*, *b*,



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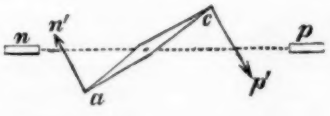
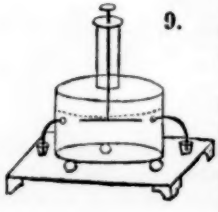


8.

into a vessel filled with acidulated water, as high as *d*, *d*. The needle was so arranged, that when it hung with freedom, it was about one-fourth of an inch distant from the extremities of two platina pointed wires, *p*, *n*, which

entered the vessel on opposite sides, and could be made to communicate at will, with the opposite poles of a battery. Now the wire *p*, being positive, and *n* negative, the extremity *a* of the suspended needle would be negative, and the extremity *c* positive, by induction. The conjoined effort of the forces thus brought to bear on the needle, acting on its opposite extremities, in opposite directions, would solicit it to move on its axis, the extremity *a* in the direction *n'* figure 8, and the extremity *c* in the direction *p'*, the line of rest would be as expressed by the dots in the figure, and slow oscillations should take place on either side of that line, if the density, or other properties of the medium permitted.

9. The experiment was thus tried, and to prevent any derangement from hygrometric twist of the silk, the needle was hung on a glass thread, of sufficient length to reach above the surface of the water, and there attached to the silk; on passing the current of forty-five pairs of four inch plates, the needle immediately moved, and after two or three oscillations, took its position of rest; on being moved to the opposite side of the polar wire, an opposite motion ensued, until the same position was gained. During this movement, gas was freely liberated from the extremities of the polar wires, and also from both ends of the needle, which hindered considerably that freedom of motion, which I had hoped for in observing the oscillations. The experiment was also varied, by terminating the polar wires with plates of platina, with a view of increasing the effect; the needle was also suspended in pyroligneous ether, and the attractive power of the same battery, newly charged, was very marked; it was not so observable in alcohol, and still less in muriatic acid; in ammonia, though only one end of the needle appeared to evolve gas, it was not so obedient to the attractive force. These circumstances indicate that the phenomena of motion, as here exhibited, have not their origin in any magnetic action produced either by the disturbance of the earth or the passage of the voltaic currents. Magnetic action to be complete, requires that the bodies, along which currents are passing, should be possessed of high conducting power, hence a thermal current whose tension is almost extinct, is still capable of producing a powerful effect on a suspended needle. A current capable of producing a given deviation when moving along metallic wires would meet with resistance in passing through water, and alcohol, or ether would forbid its passage. It is moreover impossible to produce any visible effect on the platina wire of this arrangement by the action of a solitary pair, even possessing extensive surface, though the same pair if cut into lesser plates, and arranged for the production of a current of greater tension, immediately causes the movement here described. Dr. Faraday has stated, in his recent researches on this point, that there is not any proof that the poles of a battery do exercise any power of attraction or repulsion, (Bache's, Turner's Chem. page 102, idem 108,) but that opinion would appear to be inconsistent with the fact—there must be an accumulation of tension on an electrode, if the medium which separates it from its fellow, is not so good a conductor as the liquid filling the cells of the battery; and experiment warrants this conclusion.



9.

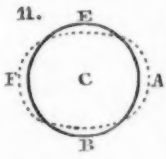
10. The principles here laid down, also indicate the construction of a GALVANOMETER, figure 9, which I have recently fitted up. It is intended to exhibit by the torsion of a fine fibre, the force of attraction between the polar wires, and the ends of the suspended needle. The only obstacle I have as yet observed to the accu-

racy of the result furnished by it, is due to the development of gas on the polar wires, and on the needle.

11. The doctrine which I wish to establish from this experiment, is, that though the polar wires are plunged in a conducting medium, and the current is actually passing, yet they still act as centres of attraction. The motions of mercury and other fluids are only exemplifications of this doctrine.

12. When a spheroidal mass of conducting matter, is brought in presence of a point of attraction, situated at a distance from its surface, the particles on that surface will be differently affected, as their situation in regard to the attracting point varies. Thus on touching the mercurial globule, named in the first part of this paper, with a negative wire, and introducing into the water a positive platina pole, the globule, which before was spherical, becomes elliptical, as represented in figure 10, two tides are formed upon it, as at *a* and *b*, one directly opposite the positive wire *p*, and the other 180 degrees from it, meanwhile there is an ebb in those regions which are situate a quadrant from the point of attraction. If the positive wire is made to revolve round the globule, both tides move, always keeping the same relative position to the point of attraction, that they had at first. It only requires the force of the battery to be appropriately moderated, to exhibit these phenomena with the utmost rigidness. And, as these motions exhibit very nearly, on a small scale, that effect which takes place on an immense scale, by the joint action of the Sun and Moon, in producing the tides of the ocean, I have given them the name of Tidal motions of Conductors, free to move.

13. Now the mechanism which produces the change of figures, from a sphere to an ellipsoid is sufficiently obvious. We have two forces under consideration. 1st. The cohesion or gravitation of the mercurial particles upon each other;—and, 2nd, the disturbing force of the polar wire, as a centre of attraction. As that disturbing force decreases in a certain ratio, as the distances increase, the mercurial particles on the side A, figure 11, nearest to the polar wire, are more attracted by it than those in the centre C of the globule, and those in the centre C, are more attracted than those at F. The particles, therefore, at A, rise towards the wire by its direct action, those at F, being less solicited towards the centre of the globule than those at E and B, the former recede from that centre, while the latter seek it.



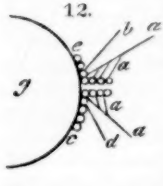
14. It has been observed, that a true theoretical tide differs in no respect from a wave. Suppose a spring tide actually formed on a fluid sphere, and the sun and moon then annihilated, the elevation must sink, pressing the under waters aside, and causing them to rise, where they were depressed. The motion will not stop, when the surface comes to a level, for the waters arrive at that position, with a motion continually accelerated. They, therefore, pass that position, as a pendulum passes the perpendicular, and will rise as far on the other side, forming a high water where it was low water, and low water where it was high water. And this would go on forever, oscillating in an assignable time, if it were not for the viscidity of the water. Now this theoretical case may be easily shown, for on approaching the positive wire towards the globule of mercury, a particular position will be gained, at which contact will take place, between the protuberant tide on the mercury and the wire. In that moment the cause of attraction is annihilated, the whole current of electricity now passes along perfect conduc-

tors, hence fulfilling the supposed case of an actual annihilation of the sun and moon, at the time of a spring tide. And the same reasoning that held in one case, equally applies in the other; the mercurial tide falls with an accelerated motion, and the line which before was the conjugate axis of the ellipse, now becomes the transverse; a tide being produced at right angles to the former one. But here the strict comparison ends, for as the mercury ebbs from its protuberant position, the metallic connexion breaks, and the wire is again put in action as a point of attraction,—the motion of the ebbing tide is checked,—it flows once more,—once more the metallic contact is complete, and when the tide falls,—it is only to flow again, as long as the battery current passes. Tides take place at right angles to each other, in a series too rapid to be counted, and the whole surface of the mercury is worked into those various and beautiful undulations which have been before referred to.

15. In endeavouring to ascertain the true cause of these phenomena, the French philosphers were, I believe, the first to observe these motions in the water, or other liquid of communication, as if a gentle wind played over its surface, bearing light bodies in its vortices. The explanation of these appearances, I here add, because no one as yet has given it, and it affords an illustration of certain propositions delivered by Sir I. Newton, in his principia, concerning the doctrine of pulses in elastic fluids.

16. We have hitherto been considering a globule of mercury, as a substance mathematically fluid. Such, however, in effect it is not, the water in contact with it possesses those properties in a much more eminent degree, so that in comparison with it, the mercury may be regarded, as a solid resisting obstacle. Now about a year ago, I showed that when a voltaic current passes through a system such as this of mercury and water, the capillary pressure on the bounding surface is changed; but, if the attraction of the wire which is introduced into the water, and which is the ultimate cause of this dynamical derangement decreases in a duplicate ratio, it follows that this disturbance of pressure, obtains only to a limited extent on the surface of the mercury; or in other words, the excess of pressure produced by a voltaic current, is not spent equally on all parts of the mercurial surface, but those which are adjacent to the positive polar wire, are more affected than those at a distance. Newton has shown (Pr. v. 2, B. 2, pr. 41) that if the particles of a fluid do not lie in a right line, a pressure propagated through that fluid, will not be in rectilineal direction, but the particles that are obliquely posited, have a tendency to be urged out of their position. So the particles *a a a a*, figure 12, pressing on the particles *d b*, which stand obliquely to them, by reason of the shape of the mass of mercury *g*, have a tendency to be urged from their places towards *e* and *c* respectively, and the motion thus produced in a fluid, diverges from a rectilinear progress into the unmoved spaces, and such a pressure taking effect on a liquid free to move, continually return the moving particles, to their first position, after making them describe an elliptical orbit.

12.



17. It has been remarked, that the basis on which this explanation essentially rests, is that a wire, from which an electric current passes, acts still as a point of attraction; an effect which involves the conducting and other electric properties of the system, on which the experiment is traced. Hence we gain an insight into the cause of the paralysis of these motions, by the addition of certain substances,—the spiral motions going on the surface of

the water, have these explanations complicated with another consideration, —the figure of the mercurial mass.

Observations upon the facts recently presented by Professor Olmsted, in relation to Meteors seen on the 13th of November, 1834. *By* A. D. Bache, *Prof. Nat. Philos. and Chem. Univ. Penn.*

Before proceeding to examine the new facts recently put forth by my friend, Prof. Olmsted, in regard to meteors seen on the 12th and 13th of November, 1834, it will be well to state what is the difference of opinion between us.

Prof. Olmsted I understand to assert, that there was a recurrence of the meteoric display of November, 1833, in 1834, thus verifying a prediction made by him as a consequence of his peculiar theory. With that theory, further than as it is borne upon by facts in regard to the prediction founded upon it, I have not at present any concern. Independently of theory, it would be a very curious fact, if it were made out, that meteoric displays of an unusual kind occurred annually on the same night; and I was induced to observe on the night of the 12th–13th of November, 1834, with reference to facts rather than theory. Prof. Olmsted states his conclusions from observations made at New Haven, in these words: "On the morning of the 13th of November, 1834, there was a slight recurrence of the *meteoric shower* which presented so remarkable a spectacle on the corresponding morning of 1833."*

My views, as resulting, first, from observations made at Philadelphia on the morning of the 13th, are, that "there occurred on the 13th of November, 1834, no remarkable display of meteors of the kind witnessed in 1833." To sustain this, after recording the meteors seen by me on the 13th of November, 1834, I undertook to show, 1. That the meteors which I saw were neither in degree nor in their peculiarities like a portion of the meteoric phenomenon of November, 1833. 2. That they were similar, both in degree and kind,† to common meteors. The small number, and absence of a common radiant, support the first position. The nearness to the number frequently seen at a period of the night, and a period of the year when these meteors are less frequent than early in the morning and late in the autumn, together with the very different points in which their paths, if produced, would have intersected, show the second.

The new facts presented by my friend, Prof. Olmsted, and upon which I now proceed to remark, are classified by him as "foreign testimonies" and "domestic testimonies." The first are somewhat particular, but the latter quite general. The foreign testimonies alluded to, are those of the Rev. W. B. Clark, A. M. F. G. S., &c., and W. H. White, Esq., both of England. These gentlemen saw meteors on the morning of the 13th of November, 1834.

The opinion of Mr. Clark in relation to the meteors which he saw, is to be found in the same paragraph from which Prof. Olmsted has quoted his

* Amer. Journ. Sci. vol. xxv. p. 363. Journ. Frank. Inst. vol. xvi. p. 368, in an article headed *Zodiacal Light*, between which and the meteors, Prof. Olmsted's theory leads him to infer a connexion.

† This term, which I used to denote the peculiarity in regard to the paths of the meteors, has, I find, been misunderstood. I did not mean to express by it an opinion that the meteors of 1833 had a physical cause different from that producing ordinary "shooting stars."

observations. It is thus expressed: "The coincidence between these and those seen in America and Europe on this day of the month, is curious, *but those which I now mention were electrical, and of no uncommon character.** In a subsequent paper, after reviewing the observations made by Prof. Olmsted, Mr. Twining and myself, in America, and by Mr. White and himself in England, the Rev. Mr. Clark thus concludes:† "One fact is at least established by these seeming contradictions, viz. that *common electrical*‡ meteors did appear both in America and England, on the same night, whilst there is no direct evidence to show that any others also appeared."

I have considered the opinion of Mr. Clark respecting what he saw, as the more important, because his description of the direction of the meteors is not very precise. He says they were in the direction of a line from Leo to the star Mizar. He may mean that their paths coincided with this line, or merely that they were parallel to it. Taking the former statement as most favourable to the similarity of this phenomena to that of 1833, it would still, however, be very different from that, however remarkable in itself. That fifteen meteors should fall precisely in the same line, is certainly a curious fact, but as certainly a very different one from the apparent convergence to a single point of the paths of more than 207,000 falling in very different parts of the heavens.

The Rev. Mr. Clark further states, that he saw one meteor which appeared to pass to the south of Ursa Major, and between Cor Caroli and Aucturus, the most northern of these stars being about seventeen degrees greater in north polar distance than Mizar. If this was one of the fifteen meteors before alluded to, Mr. Clark probably intended his description to apply to the general direction, and not to the precise position of their paths. This, however, is not important so far as the inference in regard to the question between Prof. Olmsted and myself is concerned.

The greatest number of meteors which Mr. Clark saw was fifteen in fifteen minutes, or else he only observed fifteen minutes; which is the correct supposition his account leaves doubtful. The portion of the heavens his view embraced is also doubtful: he merely states that he observed from a window. To make the hypothesis as favourable as possible to the number of meteors, we may suppose that he observed but for fifteen minutes, and saw fifteen meteors; that his range of vision embraced not more than one-tenth of the visible heavens, and that meteors fell in equal numbers over an equal space in other quarters. All these assumptions, and they are for the most part gratuitous, would make the number over the whole sky six hundred in one hour, while during the display in 1833, six hundred and fifty meteors§ were counted in about one-fourth part of the sky in fifteen minutes, making upwards of 36,000 in one hour, and this only one hour and a quarter before sunrise.

The observations of Mr. White do not seem to me, any more than they do to Mr. Clark, to support the idea of a recurrence of the meteoric phenomenon of 1833. The number of meteors which he saw was ten in half an hour, being less than the number seen in fifteen minutes by Mr. Clark. The observations were made from windows which commanded a view of the north and east, and supposing that they commanded but one-sixth part of the heavens, and that the meteors were of the same frequency in every part,

* Loudon's Mag. Nat. Hist, vol. vii. p. 655. † Ibid. vol. viii. pp. 420, 421.
‡ This term, electrical, is in allusion to his theory.
§ Amer. Journ. Sci. vol. xxvi. p. 367

we should have one hundred and twenty meteors for the whole sky in one hour; one-three-hundredth part of the probable number visible in 1833, at Boston, in one hour. During the display of 1833, ninety-eight meteors were seen in fifteen minutes, the rate being three hundred and ninety-two per hour, within three-quarters of an hour of sunrise.

Neither does it appear that the meteors seen by Mr. White had an apparent radiant. One of the meteors of which he speaks, "glided almost perpendicularly towards the earth: this was succeeded by another of a most brilliant appearance,which took a westerly direction."

The ten meteors to which I have before referred, are said to have appeared between Leo, Virgo and Ursa Major. This place, as assigned in a general description, is a matter of course, since these were the principal constellations within view from the north and east windows from which Mr. White observed. Nothing is said about a radiant, too remarkable a fact to have been overlooked, had it existed.

But the number of these meteors has frequently been equalled, and even exceeded, in cases, between which and the meteors of 1833, no connexion has been claimed. I need only quote a few cases. On August 8th, 1823, Professor Brandes noticed sixty-five in two hours. On August 10th, "one hundred and fifty were noticed in less than two hours, and Professor Brandes remarks that they were obliged to leave many unrecorded."* During August, 1833, Mr. Espy and myself noted, over one-fifth of the visible heavens, thirty-seven meteors in one hour. We have noted eight in fifteen minutes, six in nine and a half minutes, five in ten minutes; and this at a time of the evening, and at a season when meteors are comparatively infrequent. At other times one meteor only would be seen in half an hour, showing the variable nature of the occurence, even on the commonest occasions. Prof. Olmsted himself refers to *showers* of meteors seen in *April*, 1833 in Virginia, in England on the *nineteenth* of *November*, in France in *April*, 1833, in August, 1833 in England, &c.

There is no connexion in point of time, between the English observations and those made in America. The meteors seen by both Mr. White and the Rev. Mr. Clark, occurred at a time when meteors were not frequent, even at New Haven.

The "American testimonies" given by Prof. Olmsted would determine the question if it were *did meteors occur on November* 13*th*, 1834; but upon the one really at issue they do not bear. The authorities, consisting of a member of the Theological Seminary at Andover, an anonymous writer in the St. Louis Observer, and a female servant at Zanesville, give no particulars on which to found an opinion as to the nature of the meteors which they saw. The St. Louis Observer merely states, loosely, that he saw, at five, A. M., in fifteen or twenty minutes, thirty or forty meteors. The accounts want the precision necessary to form any opinion in the case.

In regard to the remarks which my friend, Prof. Olmsted, appended to his facts, it is necessary to observe, first, that in addition to the indirect evidence of no meteoric displays having been seen at eleven military posts from Maine to Florida, six western posts, and five on the northern frontier, and which he notices, I presented other *indirect evidence*, not noticed by him, derived from scientific friends at Wilmington, Baltimore, the University of Virginia, and the University of North Carolina; and *direct evidence*, also unnoticed by him, from observations at New York, Philadelphia, and Nash-

* On shooting stars, by E. Loomis. Amer. Journ. Sci. vol. xxviii. p. 96.

ville. Further, that a sentinel at Mackinac, where meteors *did* fall in considerable numbers, saw and remembered the fact. My friend states his preference for the testimony of nautical men, and yet of all those who navigated between this and England, on the night in question, not one has recorded observations of any extraordinary meteoric occurrence like that of the 13th of November, 1833.

In the second remark, allusion is made to a record on the minutes of the American Philosophical Society. This record* is there entered as a "verbal communication in relation to the result of observations on the recurrence of the remarkable meteoric display of November 13th, 1833." This record rests, not on the responsibility of that learned body, but on my own, and I believe I have shown full warrant for it. Records are made of all verbal communications presented to the Society, and among them will be found a reference to the new facts presented by my friend, Prof. Olmsted, as the substance of another verbal communication made by me.

In conclusion, I think the examination of those of the new facts which are susceptible of such a course, has conclusively shown that the meteors referred to in them were of ordinary character. And a comparison of this result with the inferences which I have elsewhere drawn from my own observations, and those of others, leads to the conclusion, that no satisfactory evidence has yet been presented of the occurrence, in 1834, of a meteoric display, which, in numbers, in peculiarities, or in connexion (as parts of the same phenomenon) and extent combined, was such as to connect it with the meteoric display of November 13th, 1833.

Bibliographical Notices.

The Book of Science. A familiar Introduction to the principles of Natural Philosophy, adapted to the comprehension of Young People. Part III. Chemistry. [Philadelphia, Carey, Lea & Blanchard.]

The little work now before us is one of a series on Natural Philosophy. It has a merit which is rare in books of its class, that of accuracy. The preparation of elementary works is too often undertaken by the half learned in the subject of which they treat. Hence erroneous, partial, or inaccurate, views are sometimes instilled. It is a high distinction of our time, that men the most eminent in the different branches of science, have applied themselves to the preparation of popular works. The difficulty in such cases seems to be that few are able to come down sufficiently to the comprehension of the general reader. And few stand so high that their reputation may not be touched by treating a subject superficially. The class of works now referred to is however, a different one from that to which the subject of the present notice belongs.

Chemistry is a difficult subject to bring down to the comprehension of the young in a book: it requires experiments to illustrate, and frequent verbal explanations to relieve difficulties. A teacher who would take in hand the Chemistry of the Book of Science, and follow it in his experiments, and accompany it by his explanations, would do a good service to the youth under his charge, for the information is exact and such as he may rely on himself. It is besides generally brought up to the Chemistry of the day.

* This quotation from the minutes, which are not published, is made by permission of the Society.

If however the work should be placed in the hands of youth without such auxiliary aid, we doubt if they could at all comprehend it, or if they would be at all attracted by the science which it contains. Lively as some portions of it are, the general character is that of dryness. Hard words are not spared, and matters hard to be understood are unfolded. It would in fact, fully employ a teacher's thoughts, and he would be gratified with the task of expounding.

In schools where an elementary course of chemistry is taught by experiment and with verbal explanations, this work will, we are of opinion, be found useful. The typographical execution of the book is good, and the cuts though plain are generally illustrative. B.

The American Almanac and Repository of Useful Knowledge, for the year 1836. [Boston, Charles Bowen.]

This is the seventh volume of a very useful and creditable American work, containing a body of scientific and other useful matter, which must recommend it to very various classes of readers.

The astronomical department of the Almanac is as heretofore under the charge of Mr. R. T. Paine, one of the most zealous of our devotees to this branch of science. Besides the usual valuable matter requiring a yearly change, additions have been made to the tables of this branch, and a table of the moon's librations has been added. The table of longitudes has been corrected in several cases from observations either made or collected by the editor, and we have especially remarked, that the positions given to Charleston, Beaufort, (S. C.) and Savannah, differ considerably from those heretofore assigned. The arrangement of the tables which was made anew last year is continued, and if change of location were not objectionable in a book of reference, we should be disposed to prefer the new arrangement.

Of the astronomical phenomena predicted for 1836, the principal will be a solar eclipse to occur on the 15th of May. The general eclipse will first begin (at 5h. 58.4m. mean time at Washington) at a place in South America, the latitude of which is 2° 9′ S. and longitude 76° 51′ W., and end (at 10h. 48.4 mean time at Washington) at the place in the Mediterranean the latitude of which is 35° 11′ N. and longitude 28° 50′ E. The calculations of the general circumstances of this eclipse, and of the beginning, middle and end, &c., for seventeen places in or near the United States, with the approximate result for twenty-four others are given in the Almanac.

The second part of the Almanac, devoted to statistical and other information, contains papers on the statistics of crime in France, on Pauperism in France, on Agricultural and Rural economy, besides a mass of valuable statistical information relating to the United States and to the individual States, to religion and to education. The work contains a distinct head for meteorological information. It has indeed been reproached by a contemporary with containing too much matter, an objection not often to be urged to a work of so moderate a price, and one which needs only to be urged forcibly to induce a most extensive circulation. Such a circulation we heartily wish it may obtain. B.

Mechanics' Register.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JUNE, 1835.

With Remarks and Exemplifications by the Editor.

1. For a *Thrashing Machine;* William Laighton, Portsmouth, Rockingham county, New Hampshire, June 6.

This patent is taken for an improvement on that of November 17th, 1834, described Vol. 15, p. 397. The claim now made is very similar to that in the original patent, and does not in any manner allude to new improvements; the patentee says, "the principles I claim as my invention, are the conical ribbed cylinder, and the semicircular ribbed cradle conforming thereto, by which, from the angular position with which they come into action, the hull of the grain is split without injury to the seed." As these *principles* made a part of the first patent, the claim cannot be sustained under the present one, or a man might renew his patent forever. The claim, to have been valid, should have pointed to those improvements only which the patentee has made since November 1834.

2. For an improvement in the *Theodolite;* Samuel Stone, Long Green, Baltimore county, Maryland, June 6.

The patentee states his improvement to be "in the art of measuring distances at one station with a theodolite, or any other instrument by which an angle can be made either perpendicularly or horizontally," &c. The patent, however, is taken for an improvement in the instrument, and not in the art of using it. He says, "the first improvement which I claim is the mechanical addition to the common theodolite, by extending the diameter of the horizontal limb for the purpose of forming a surface as well as a centre on which a circular rim or plate revolves, as already described; and also the application of the logarithmic calculations as applied to the circle, as already described. But I particularly claim the improvement of measuring distances by an angle at one point or station, using the pole or stave, with its graduations, for one side of the triangle."

With respect to its construction and use, the inventor says:

"This instrument embraces all the principles of a modern theodolite; besides which, it contains the following improvements: The first improvement is a circular revolving plate, sliding or resting upon the limb of the instrument, the upper surface of which forms a plane with the upper surface of the limb; on which are delineated a set of mathematical numbers, which supply the place of a table of logarithms, and all other logarithmic tables.

"In the second place, this instrument is so constructed as to supersede the necessity and use of a chain in all cases. The distance of any visible object can be ascertained at one station, as far as the flag staff can be distinctly seen through the telescope of the instrument, to the exactness of chains, links, and decimals.

"It also calculates the latitude and departure of every course run, and the base and perpendicular of all elevations. It further embraces all the fundamental rules of common arithmetic, viz: multiplication, division, single rule of three, interest, mensuration of superficies and solids, guaging, &c.

Any question in plain trigonometry, right angled or oblique, can be solved on the instrument correctly; including all questions that can be performed by logarithms or logarithmic tables. The whole without the use of figures or a mathematical calculation."

The instrument has received the approbation of the New York Institute, the managers of which have awarded their highest premium, a gold medal, to the inventor.

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3. For *Extracting Gold from its Ores;* Nathaniel Bosworth, city of Philadelphia, June 6.

"The improvements herein described, for which a patent is asked, consists in the arrangements and connexions by which we are enabled to collect the particles as soon as disintegrated from the rock, thereby preventing their becoming armed with stoney matter as in the old process, which prevented the gold from coming in contact with the mercury. Also, by preventing the gold from parting with a portion of its substance in forming the streak upon rocks in contact during the operation of stamping, which has heretofore been a source of waste. By the old process the gold was necessarily stamped so fine as to flow over the top of the bocard with the water. By the new process the gold is carried out even with the bottom of the bocard, retaining its size and form as when in the matrix. Also the use of *silver or gold plate surface*, by which we obtain a new agent, that of mechanical pressure, in addition to chemical affinity. Should it not be convenient to obtain the precious metals for the amalgamating plates, and a substitute be used, such as brass, copper, tin or bismuth, it will be proper to subject the amalgam to the action of a single acid that will dissolve the baser metal and not the gold; for if tin, zinc or bismuth, or some of the other metals be combined with gold by melting, it then becomes extremely difficult to separate them."

"As other metals than gold and silver may be used, I claim not only their employment for the purpose described, but, generally, the amalgamating upon a hard fixed metallic substance of any kind, quickening the same by the smallest quantity of mercury which will answer the intended purpose of arresting the particles of gold in their passage over it, whereby I expose any required extent of quicksilvered surface, on which the gold will become firmly attached, or the particles effectually united."

Several drawings accompany the specification, and are referred to in it, affording a complete view of the apparatus.

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4. For *Constructing Coffins of American or Hydraulic Cement;* Daniel Dayton, Hiram Hoyt and John White, Salina, Onondaga county, New York, June 6.

"This improvement or invention consists in making coffins of the American or hydraulic cement, and that improvement or invention is hereby desired to be patented."

We think that the making of a vessel or box in the form of a coffin, out of a material of which various vessels have been previously made, will neither be viewed as an invention or improvement in the eye of the law, nor do we perceive how such an *invention* could employ the powers of three individuals.

5. For an improvement in the *Truss for Hernia;* John L. Heintzelman, city of Philadelphia, June 6.

"Now all that I claim as my invention and improvement, and for which I ask letters patent, is the mode of placing the metal disk of the pad between the two sheets of caoutchouc, impressed and united as herein described and set forth, instead of placing it, as formerly, behind them, and dispensing with a covering of silk, leather, or any other substance whatsoever; thereby rendering the pad more elastic, more simple and durable, and perfectly easy to be cleansed without difficulty."

The caoutchouc pad is formed by pressing two sheets of caoutchouc, cut to a suitable size and shape, between heated metallic dies, by which the edges of the substance are united, and a proper form given to each side of the pad, the brass plate being enclosed between them, with a suitable tube projecting from the back of the pad, by which to attach it to the spring.

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6. For a *Pyrimidal Stove;* Thomas M. Southwick, Troy, Rensselaer county, New York, June 6.

This is a sheet iron stove lined in the furnace part with soap stone. The only peculiarity which we see in it, is the forming of an air-tight chamber at the lower part, from which tubes are to ascend up into the furnace. The object proposed is to heat the lower part of the stove by the descent of heated air into the chamber; it will be found, however, that more heat would be conducted down by solid rods than by the air tubes: the contrivance is, in fact, at variance with well known principles.

"The invention claimed and desired to be secured by letters patent, consists in the arrangement and adaptation of the several parts of the stove so as to produce the one described; but I particularly claim the tubes which convey the heated air *downward* into the close vessel below for warming the feet, and the construction of the furnace containing the coal."

The description is very confused and indistinct, and the claim corresponds well with it.

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7. For a *Machine for Mixing Mortar and Hoisting Brick;* Jesse Rinehart, Danville, Vermillion county, Illinois, June 6.

A horse power is to be used to turn a cylinder furnished with projecting pins, and revolving within a concave, into which the sand and lime are to fall from a hopper. As in the preceding patent the description is altogether defective. Nothing is said about the construction of the hoisting part; we are only told that "the mortar or brick is hoisted by the same power which makes the mortar, and much in the same way as other hoisting machines." The drawing represents several things not alluded to in the specification.

The claim is to "the arrangement and adaptation of the several parts of the machine so as to produce the one before described, for mixing mortar and hoisting materials combined.

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8. For a *Machine for Hulling Clover Seed and Rice;* Winslow Braley and Jeremiah Walker, Phillips, Somerset county, Maine, June 6.

This machine consists of a grater or rubbing board, worked up and down by means of a lever, the seed descending between this and a stationary grater. The graters are made of punched sheet iron, fixed upon wooden cylindrical segments crossing the rubbing boards. The machine is well described, but there is no claim made, although it certainly possesses sufficient

originality upon which to have founded one. Several parts referred to in the specification, have been omitted in the drawing; it is therefore defective, as it would not be a sufficient guide to a workman about to make the machine it represents.

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9. For a *Thrashing Machine;* Hugh and Isaac W. Edgar, Wayne county, Ohio, June 6.

This is called a "Portable Grain Thrasher," but a horse power, which is certainly a separate and distinct machine, is also described in the same specification. The thrashing machine works by a cylinder and concave, and the general construction of the horse power is the same with many others.

"We claim, as our improvement, the peculiarly simple and substantial construction of the frame of the horse power and machine. The cheap and durable form of the master wheel; the proportionate shape of the bevil wheel, which gives it greater strength in proportion to the weight than the usual plan. The square pieces of iron with pins on the corners in ratchet joint, which are easier made, more substantial, and work with less friction at a great angle than those used heretofore. The form of the bar and bar tooth cylinder, the teeth of which are not liable to fly out by the centrifugal force of the cylinder when in motion. Placing wood or flat bars between the bars in the concave, which leave greater space for the grain. The regulating the concave to or from the cylinder with keys, to suit the state of the grain. The ratchet wheel shaft passing through the machine, so that the tumbling shaft may be attached to either end to suit different situations. Placing half the gearing on the machine, which reduces the motion of the tumbling shaft, and simplifies the horse power."

If the patentee can sustain all the foregoing claims, together with an exclusive right to his two machines, he will do more than we believe he can accomplish.

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10. For a *Cooking Stove;* Elijah Skinner, Sandwich, Strafford county, New Hampshire, June 12.

This stove is to be set in a common open fireplace, and differs so little in its general arrangements from some others, as not to require or to admit of special description. The claim is to "the particular arrangement and effect of the flues, funnels, damper and oven, and the appendages for letting off the steam; and the application of the whole to the common open fireplace, as before described."

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11. For an improvement in the *Common Fireplace;* Ira A. Bean and Elijah Skinner, Sandwich, Strafford county, New Hampshire, June 12.

A box is to be formed across the fireplace somewhat like a hollow iron back-log; below this box or furnace there is to be an air chamber, and a plate is to rise vertically near its back edge, so as, with the chimney back, to form a flue for the escape of smoke. In the top plate of the box there are openings for cooking utensils; there is an opening also for admitting fuel, and tubes to let heated air into the room, which, however, will never produce this effect, as the draught will be the other way. The claim is to "the construction of the box in the hearth, and the arrangement and application of the same, with the flues, funnels and false back, to common open fireplaces; the object of which is to save room and fuel, furnish a cheap and

convenient apparatus for cooking, and at the same time avoid the impure air occasioned by close stoves, and the steam from cooking stoves."

The whole of the above named objects will not be attained by means of this contrivance; we do not think that there will be any special convenience in its use, and it certainly will not be economical when intended for heating in the place of a well constructed close stove.

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12. For a *Thrashing Machine;* Thomas Rucker, Jr. of Murphreysborough, Rutherford county, Tennessee, assignee of Pendleton Check, of the same county, June 12.

In this machine there are two revolving cylinders, one placed over the other; the upper one is furnished with knives or cutters, acting against an opposing fixed cutting edge, and these together operate in the manner of shears. The grained ends of the sheaves are fed to this cutting apparatus, and the pieces cut off fall between a thrashing cylinder and a concave, grooved from end to end, in the form of saw teeth. by which the grain is thrashed out. The claim is to "the manner of separating the heads of wheat or other grain from the straw, previous to thrashing it by the combination of machinery herein specified and described." It is said that in this instrument "the wheat is thrashed out more completely, and with far less labour than in those machines where the whole sheaf is operated on."

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13. For a *Plat-form Balance;* Alexander Bliss, Benson, Rutland county, Vermont, June 12.

"What I claim as my own invention, and not previously known in the above described machine is,

"*First,* The arrangement of the levers, by which they form parallel lines and right angles, in the construction of the machine.

"*Second,* The application of crank suspensions attached to the axle.

"*Third,* The described swing and its crank suspensions.

"*Fourth,* The employment of the swings in front and rear of the machine described in the specification, upon which the short arms of the upper levers rest."

Those acquainted with the platform balance will see from the foregoing, that there is nothing essentially differing from it in the action or construction of the machine proposed by this patentee. We are not aware that any advantage can result from arranging the levers all at right angles, and think that in this and some other points the change is in form rather than in substance.

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14. For an improvement in *Bridges;* George Law, Easton, Northampton county, Pennsylvania, June 12.

The object proposed to be attained by the patentee is without lessening their strength, to give increased height to wooden bridges, thereby admitting of the passing of high loads, and of locomotives without lowering their chimneys. The framing of the bridge is to be the same as that now most commonly adopted, namely, double posts passing from one chord to the other with diagonal braces between them, thus forming a truss frame. The patentee says, "what I claim as my improvement and invention in the above described mode of construction, is limited to the additional stories, or tiers, of truss frames above the first or lower-most one, (which one has been used before.) I do not claim the principle of sloping the braces at right angle,

nor the use of the arch, but simply the repetition or additional combination attained by adding tier upon tier as above described."

There certainly is but little, if any, invention in the foregoing plan; and, in most cases, the increasing the height of a bridge is objectionable from its greater exposure to injury by wind; independently of this consideration, we do not apprehend that any builder would find it difficult to increase the height of such structures without the fear of weakening them.

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15. For a *Cheese Press;* David Phelps, Bangor, Penobscot county, Maine, June 12.

A windlass crosses the frame of the press, near to its bottom, the ends of the shaft passing through the cheeks so as to draw upon ropes, which are to communicate the pressure; a rope from each of these projecting ends is attached above to a bent, or progressive, lever, working upon suitable fulcra, and bearing at their inner ends against a follower, which they force up; they have friction rollers on their ends to enable them to operate freely. There is no claim made, although the patentee says that it "has advantages over all others in use, for reasons, which may be seen at a single view." This may be the case, but we do not think so, although we have no doubt that it will answer the purpose intended in all its parts; but in all its parts it is not new.

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16. For an improvement in *Fireplaces for Grates to burn anthracite;* Joseph Snyder, Philadelphia county, Pennsylvania, June 12.

The greater part of this fireplace is proposed to be made of cast-iron; the bottom of it is formed of two parallel plates, two or three inches apart, and constituting a part of a circulating flue. This may stand upon feet, raising it a little from the ordinary hearth, and on it rests the back and jambs, the back also being formed of double plates, connecting with those at the bottom. The grate is situated as is usual in open fireplaces, and above it are double top plates also forming a flue between them. Hollow columns at the corner of this fireplace, in front, connect the hollow hearth with this hollow top, the back end of which passes into the chimney, in the manner of a Franklin stove; there is a damper situated on the lower plate of the upper base, which being opened allows of a direct draught into the chimney, but when closed, causes it to circulate around the whole structure. The grate is lined in the usual way, and supposing the damper to be closed, the draught is over the sloping back into the back flue, then downwards between the two back plates, then forward in the hollow hearth, and upward through the columns into the cap flue, and back into the chimney. The claim is to "the principle of diffusing the heat of an open fireplace or grate to the hearth and parts situated below the fire, by a descending and ascending flue, or flues, and double hearth, as set forth and described."

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17. For an improvement in *Stoves;* John C. Parry, Pittsburgh, Pennsylvania, June 12.

Although many patents are taken for trifling things, the one before us may be considered as standing alone in its own littlenes. The whole thing proposed is to cover the rods used for connecting the tops and bottoms of Franklin, ten plate, and other stoves, by half columns of cast iron.

18. For a *Saw Set;* Herrick Aiken, Dracut, Middlesex county, Massachusetts, June 12.

The description of the saw set is very imperfect, or the instrument itself is strikingly so. There is to be a small piece of steel with a rounding face set in an iron bed, and upon this the setting is to be effected. Two horns, or projecting pieces on the bed, are employed to hold the said blade in its place, and there is to be a regulating guage, which in the drawing is represented as having teeth on it like those of a saw, and we are told that "the set of the teeth is performed by a hammer, or hammer and punch. The claim is to the foregoing parts." We know something about saws, saw sets, and saw setting, but should be at a loss, with all the helps before us, in attempting to construct and use the foregoing instrument.

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19. For *Splitting and Paring Leather;* Herrick Aiken, Dracut, Middlesex county, Massachusetts, June 12.

This machine is for cutting or skiving leather after it has been cut in strips or pieces to the required length and width. Like the foregoing, it is but imperfectly described, and could not, therefore, be carried into effect without the aid of invention. A cutting knife is to enter horizontally along a cast iron frame, and what is called a *revolving regulator*, which we are told "is an inclined, hollow semicircle," is placed above the knife, extending between two upright studs, to which, we suppose, it is attached by gudgeons, placed eccentrically, so that when turned down over the edge of the knife, its distance therefrom may be regulated by its eccentricity, and thus serves as a guage for different thicknesses. There are some other parts for which we could suppose a use, and a mode of fixing, but this is rather a departure from our general design. Very simple instruments have been long in use for the same purpose, and although this is called an improvement, the term must be taken in its technical acception only, meaning that it is not precisely like those which have preceded it.

The claim made, is to "the arrangement and adaptation of the several parts of the machine so as to produce the one before described, and particularly the method of confining the knife, and the construction of the regulator." The former part of the claim may be tacked on to any specification; the latter portion is to things not properly described.

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20. For an improvement in *Pumps and Fire Engines;* Henry Gates, Northampton, Hampshire county, Massachusetts, June 12.

The body of this pump is to be a short cylinder or drum, its axis standing horizontally, and truncated or cut off on its upper side so as to reduce it to about two-thirds of its cylindrical capacity; this upper part is covered, water tight, by a horizontal plate. An axis passes through the cylinder, and has attached to it two buckets or leaves, standing at right angles to each other, fitting the lower part of the cylinder and the two heads, water tight, to effect which they are made of durable metallic plates, screwed together with packing between them. Each of these leaves has a valve opening outwards, or towards the upper plate of the chamber.

The upper part of the drum is divided into two chambers by a fixed partition descending from the upper plate to the upper side of the vibrating axis, against which it is to fit water tight. There are two valves opening upwards on the top plate, one on each side of the partition, and these are both covered by a conical delivery pipe, by which the water is to be con-

ducted as required. The receiving pipe descends from the bottom of the chamber into the resorvoir, or chamber.

The axis is to be made to vibrate about a quadrant of a circle, and those acquainted with hydraulics will see, that if the instrument be in good order, water will be raised by it. The construction of a pump, operating as described, is claimed. We could point to very similar plans of pumps, but we do not think it necessary to touch this point. Such pumps, if made with extreme care, will work promisingly at first, but they will soon go out of order. When in the best condition. we do not believe that such a pump is equal to the common piston and cylinder, the direction of the water being quite as much changed in it.

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21. For *Heating Apparatus;* Robert Rogers, South Berwick, York, county, Maine, June 12.

This apparatus, we are informed, produces radiated heat, steam heat, and heated air at the same time, which are conjointly to be employed in the heating of buildings. The stove or furnace part may be said to consist of three concentric cylindrical vessels; the innermost of these is a circular pipe, like a stove pipe, which is to receive cold air at its lower end, below the ash pit; its upper end supplying lateral pipes with heated air at any convenient height above the fire chamber. This pipe, to the height of the fire chamber, is surrounded by a double cylindrical boiler which forms the inner wall of that chamber. The fire chamber is formed by a second double cylindrical boiler, placed at a proper distance from the former, and of the same height with it, and which is also the outer wall of the chamber, occupying the place of the ordinary lining of a cylinder stove; the grate bars and ash pit are formed as usual, and there are cold water and steam tubes leading into the boilers. The smoke pipe surrounds the air pipe, being reduced in its diameter by the conical form given to the stove above the fireplace.

The patentee believes that this stove will be very economical, producing a very large portion of heat from a small quantity of fuel, and as he does not point out any particular part of it as his invention, he appears to think that the whole arrangement is new; this, however, is a mistake, concentric cylindrical boilers forming the walls of the fire chamber having been repeatedly employed. Had we time to dwell upon it we could easily point out what we consider as great practical objections to the contrivance.

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22. For an improved *Wind Mill for Raising Water* to set machinery in motion; David W. Hurst, Newbury, Essex county, Massachusetts, June 12.

How much the patentee is mistaken in his ideas and expectations as regards this contrivance, will be apparent from his own words; we therefore give what he himself says; a procedure the fairness of which he will not gainsay.

"This invention, it is believed, possesses advantages above all other machines now in use, inasmuch as with a small breeze of wind a crank placed at the upper part of a common windmill, will be set in motion. and being connected with machinery in the windmill, embracing four pumps or engines also connected, will raise from a pond, well, or spring of water, into a resorvoir placed in or near the mill, as may be convenient, a sufficient quantity to set in motion any variety of wheels and machinery required for grinding,

and for all other purposes for which such machinery is used by cabinet makers, and in other manufactories, being conducted from the resorvoir on to an overshot wheel by common pipes; and possesses the important advantage of being set in motion by a slight breeze of wind, bringing into use the full power of the water upon machinery which may conveniently be placed under any building in which it may be required to be used."

The drawing represents a windmill working four force pumps to drive the mill wheel. If the thing was good for any thing it was not patentable, as the raising of water by windmills for various purposes is a very old invention; but the whole proposition shows an entire want of knowledge upon the subject.

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23. For a *Mortising Machine;* Jonathan Page, Hennike, Merrimac county, New Hampshire.

There is, of necessity, a considerable resemblance among the various mortising machines which have been patented, their differences consisting in a more or less convenient mode of arraying the parts; all we shall give relating to that before us is the claim.

"Your petitioner claims the construction of the frame for receiving the piece to be mortised, with a movable *rest* and *guard*, different from any in use, whereby materials of different sizes may be more conveniently mortised, and wheel hubs, in particular, of all sizes, are mortised by the use of a cheap and simple carriage for confining them. He also claims the use of common chisels in the operation of his machine, and the cheap and simple construction of the whole."

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24. For an *Oven;* Samuel Pollard, Bucksport, Hancock county, Maine, June 12.

A cylindrical sheet iron oven is to be placed in the chimney of a common open fireplace, its front resting on the iron mantel bar, and its back end being supported in any suitable way at the back of the chimney. An additional flue is to be made under the oven, just above the fire, to heat the back end of the oven more effectually. The contrivance has little or no novelty, and is very far inferior to some similar inventions. It may be put up cheaply, but that, alone, is not a sufficient recommendation. There is no claim made.

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25. For a machine for *Shaving Staves, Heading, and Shingles;* John Everhart, Wayne, Warren county, Ohio, June 12.

This machine operates much in the same way with some others, that is, the stave or other article to be shaved is held down by a pressing roller, and is forced between cutting knives by means of a lever acted upon by a windlass. The claim made is "to the use of the lever geared as herein described, operating in combination with the knives and other part, in the manner, and for the purposes herein set forth." We think that there are certain parts of the machine which might have been specially claimed, in addition to the manner of acting upon the lever, and they might be more safely depended upon than the general action of the machine.

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26. For a *Machine for Shelling and Grinding Corn;* George M. Weaver, Montgomery Square, Montgomery county, Pennsylvania, June 12.

The shelling is effected by means of a revolving cylinder, the corn being fed in by hand; the feeder, which reacts against the cylinder, has some peculiarities in its construction, but the whole machine does not essentially differ from some others. The grinder is merely a cast iron frustrum of a cone, furrowed on its smaller end, and on its edges, which revolves in a corresponding cast iron pan or box. The claim is to "the construction and arrangement of the feeder, operating with the cylinder, in the manner described; and also the construction of the grinder, by which it is made to grind on the conical and front surfaces at the same time."

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27. For *Wooden Hames;* Sereno Norton, East Bloomfield, Ontario county, New York, June 12.

These hames are to be made of any hard close grained wood, and are to be formed much like the horse collar, for which they are to operate as a substitute. The mode of uniting them together by straps, and of attaching the gearing to them, with some other things relating thereto, are clearly enough described, and must be considered as altogether new in every part, as there is no claim.

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28. For a *Spring Seat Riding Saddle;* Jacob G. Patmer, Harvey Beard and Anthony Beard, Greenville, Augusta county, Virginia, April 12.

Claim. "Now we do not claim as new in the construction of spring seat saddles, the application of a spring to the head of the tree, nor a spring of zig-zag or W shape, as applied to this purpose. But what we do claim as new, and our invention is the form and manner of constructing the frame and attaching the spring thereto, being curved so as to conform to the gullet of the saddle, and being attached to the tree by straps and webbing, as described. We also claim the application of similar springs to the girth, or girths of the saddle, and also the iron horn secured to and covered as herein described and set forth."

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29. For a *Machine for Propelling Machinery by Weights;* Elisha Turner, North Pownal, Cumberland county, Maine, June 12.

We will present an extract from the so called specification, which, although aided by what is called a drawing, leaves the inquirer as completely ignorant of the intentions of the patentee, as though they were intended to be concealed. We guess, however, that the instrument is intended to *gain power*, although there is not even an attempt to make known how this is to be done.

"Operation. The weight being wound upon the loose barrel by manual or other power, the catch is thrown into the ratchet wheel by a spring made fast to the wheel fixed to the axle. The pinion on the end of the axle works into a cog wheel, this again into the cog wheels that convey the motion to any object required to be put in motion."

"The *invention* here claimed, and desired to be secured by Letters Patent, consists in the arrangement and adaptation of the several parts of the machine before described, for propelling machinery by weight.

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30. For *Apparatus for Cooling Water and other Liquids;* John Waring, Port Tobacco, Carolina county, Virginia, June 12.

A vessel, like a jar, for containing water, is to be placed within a wooden

box, and surmounted with *pulverized charcoal;* a second vessel containing ice is to be let down into the jar of water, and the latter when refrigerated, is to be drawn off by means of a cock.

A claim is made to "the arrangement and adaptation of the several parts of the apparatus for cooling water and other fluids." In which arrangement and adaptation there is neither improvement, invention, or discovery, if originality is considered as making a component part of these things.

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31. For apparatus for *Hoisting and Delivering Burthens from Ships;* Barnabus Pike, city of New York, June 12.

A frame is to be made by connecting two stout pieces of timber, sixteen or twenty feet long, by cross timber mortised into their ends. The long timbers for a railway upon which to support a carriage, which runs upon friction rollers on their upper edges. Stout legs are framed into the lower sides of the rail timbers, the carriage has a block and tackle attached to it, by the aid of which, and a windlass, the goods are to be raised from the hold of a vessel. The carriage is then moved along the rails, which extend on to a wharf, and the packages landed. The claim is to the carriage as above described and applied, and the principle and mode of carrying and delivering the burthens."

The whole is clearly described and represented, and at certain periods we have no doubt that such an apparatus will be very useful, but the rise and fall of the tide must, in most places, very much interfere with the employment of it.

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32. For *Antifriction Wheels;* Julian Nicolet, Pittsburg, Pennsylvania; an alien who has resided two years in the United States, June 12.

The wheel used is that of Mr. Ross Winan's, in which the axle, the friction of which is to be relieved, rests upon the inner periphery of a flanched friction wheel. The patentee says, "Now I do not claim to have invented the friction wheel described herein, but of its application to the specific purposes herein set forth," that is, to the shafts of water wheels, fly wheels, and paddle wheels, Mr. Winan's having applied them to rail road cars. Be it remarked however, that Mr. Winan's patent has not expired, nor has it been repealed, and the friction wheel itself, therefore, vests in him, and no one can take it from him under the pretence of applying it to axles of a kind differing from those to which he applied them.

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33. For a *Bee House;* William Groves, Harrisburg, Dauphin county, Pennsylvania, June 12.

Houses, or large hives, for the more convenient management and security of bees, have been variously constructed by apiarians, several of which have been made the subject of patents. In that before us their are some variations of form and management, the absolute value of which is a question of experience, and as we perceive but little of originality, and have a long list to go through this month, we shall not give the claims or attempt any description.

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34. For a machine for *Shaving and Jointing Shingles;* Samuel B. Chapman, Camden, Gloucester county, New Jersey. First patented March 15th, 1834, re-issued on an amended specification, June 12th, 1835.

Claim. "What I claim as my invention is the manner of fixing the knives within the iron frame; and the giving to one or both of them a vertical motion only, for the purpose, and in the manner, or upon the principle, herein set forth. I also claim the use of rollers, or segments of rollers, to continue the pressure upon the shingle after it has passed in part through the knives."

As this patent has been before noticed, it is not necessary to add any thing in this place to the claim now made.

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35. For a *Winnowing Machine;* Jeremiah Nichols, Chestertown, Kent county, Maryland, June 15.

This winnowing machine is said to be like most others, excepting that leather is nailed on to prevent the escape of wind, and one or two other trifling additions made which we shall not take the trouble to describe.

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36. For a *Mortising and Tenoning Machine;* Joseph H. Darby, Leominster, Worcester county, Massachusetts, June 15.

A very brief description is given of this machine, which is so similar to others that the *inventor* ought certainly to have pointed out its novelties; he, however, has failed to do this, and we have failed in the attempt to discover them; there is no claim to any part of the affair. A vertical shaft, capable of swivelling, when required, receives at its lower end, the chisel by which the mortises, or tenons, are to be made. A crank shaft, carrying a fly wheel, is to move the shaft up and down, and is itself made to revolve by means of a second crank, and a treadle. The stuff to be operated upon is placed upon a regulating shifting bed. The drawing shows two forms of chisels, but we do not hear any thing about them in the specification.

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37. For a *Machine for Washing and Churning;* Charles Otis, Finksburg, Baltimore county, Maryland, June 15. (See Specification.)

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38. For an *Auger;* William Jones, Portsmouth, Norfolk county, Virginia, June 15.

The specification of this invention is brevity itself exemplified; it consists of the following words. "This improvement is a hollow auger made so as to embrace the bolts or fastenings in ships or vessels, and to cut the wood from around them, by which means the plank, &c., can be removed, without the delay, trouble, and expense, usually required by splitting them out."

In the drawing, the augur is represented as twisted like the ordinary screw auger, but capable of allowing a bolt to pass within it. This must be a very useful thing, and, so far as we know, it is new.

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39. For a *Paper Ruling Machine;* James C. Teasdale, Dansville, Livingston county, New York, June 15.

It is said in the claim that this invention "consists in having one additional cylinder, apron, and strings, by which the paper is ruled on both sides as before described;" which description fails altogether in its professed object, being drawn up without any apparent knowledge of the subject.

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40. For a *Machine for cutting Sausage Meat, and stuffing Sausages;* Abraham and John Keagy, Franklin county, Pennsylvania, June 15. (See Specification.)

41. For an *Undershot Wheel;* Ebenezer Cochran, Gibson county, Indiana, June 15.

This is an old, and good-for-nothing contrivance. The buckets are all to swivel on pins near the periphery of the wheel, and we are told, and that not for the first time, that "A wheel thus constructed with floating and folding buckets, will run either wholly or partly under water without difficulty; and when the water has lost its force upon the buckets they will float and fold round on their pivots, with but little friction, weight, or obstruction, until they come on to the pins or cleats."

We could, with a little trouble, point to precisely the same thing; our remarks on the water wheel noticed at p. 236, vol. xi., apply sufficiently well, although the cases are not perfectly analogous.

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42. For an *Accelerated Spinner;* Leonard Norcross, Dixfield, Oxford county, Maine, June 15.

A wheel of about a foot in diameter is to work into an endless screw, which takes the place of the ordinary whirl upon the spindle. It will be needless to contend against the novelty of this mode of obtaining rapid motion, and every one acquainted with machinery will be aware that rapid destruction will also be insured, from this excellent mode of increasing friction.

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43. For *Raising Stumps, Rocks, &c.* from the ground; Leonard Norcross, Dixfield, Oxford county, Maine, June 15.

A tripod is to be made which is to be placed over the stump, &c. to be raised. A screw, standing vertically, passes through the cap of the tripod, and, at its lower end, has chains, hooks, &c. by which to hold on to the stump. A sweep, or lever, is to be drawn round by a horse, a nut on the inner end of the lever raising the screw; no provision is made to prevent the turning of the latter with the nuts.

We should think the claim just as legitimate to raise stones by a handspike, as to raise them, and other articles, by the most simple application of the screw. That such a machine properly braced, and upon firm ground, might be made to raise stumps, &c. there can be no doubt, but excepting the clearer of land can contrive to carry his stumps to the machine, he will find no small difficulty in carrying the machine from stump to stump, fixing it with sufficient stability, and obtaining a place for his horses to walk upon.

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44. For *thinning Cotton Plants;* Jordan Gatling, Murfreesborough, Hertford county, North Carolina, June 19.

A kind of instrument resembling a double wheeled plough is so constructed as that the wheels may straddle the cotton rows. One of the wheels has cogs on its inner face which take into a pinion, or trundle, on a horizontal shaft, revolving lengthwise of the machine, and carrying two hoes, or one, as may be desired, on the ends of arms, for thinning the cotton; a coulter and horse hoe are fixed on to each side rail, for siding up. Some directions are given respecting the use of the machine when the cotton may be unequal in thickness; but upon the whole its action is not rendered clear. The claim is to "the manner in which I have combined the operation of the wheels and hoes in the interior of the frame."

45. For a *Machine for Thrashing Clover Seed;* John P. Ridings, Hillsborough, Highland county, Ohio, June 19.

In this hulling machine the seeds are to be rubbed between a cylinder and concave, and the fixing of the latter so as to be borne up by springs is all that is claimed. We apprehend that this claim has been before made, or the method of doing it described, at least ninety and nine times.

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46. For an improvement in a *Forge and Bellows;* John C. Concklin, Peekskill, West Chester county, New York, June 19.

"The principle of this invention consists in the combination of a Smiths' forge, made of cast metal, with a double bellows placed underneath the bed of the forge; the bellows being of nearly the same dimensions in square, or horizontal measurement, as the bed of the forge. The forge, however, may be sustained on an iron frame work, so constructed as to be portable when the combination is made sufficiently light."

The middle board of the double bellows is to be placed obliquely, so that the movable boards may rise in reverse direction; this, we suppose is to save room. The forge back, bellows lever, &c., are described, but such forges, with the bellows beneath the fire, the greater part being made of cast-iron, are not novelties. We have one which was imported from England twenty years ago; and others very similar have been patented in the United States.

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47. For a *Hinged Boot Cramp;* Nathan Ayer, St. Johnsbury, Caledonia county, Vermont, June 19.

Although hinged boot cramps are very common things, the patentee describes his, which he does with sufficient clearness, without making any claim. He merely informs us that "its peculiar utility and improvement is shown in its application to use. Having suitably blocked out the leather to be cramped, throw the leg and foot of the cramp, by means of the hinge, as near as may be in a straight line. fasten the leather around it in the proper place by slightly sewing the opposite edges, then raise the leg and latch it, insert the wedge at the toe; then by turning the screws on the bottom of the foot, at the heel and back, the leather to be cramped will be immediately compressed into the desired shape."

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48. For *Xylographic Check Plates;* Charles C. Wright, City of New York, June 19.

The plate from which notes, or checks, are to be printed is to be covered, by means of an engraving lathe, by transferring, or otherwise, with a very light pattern, consisting of close, but fine, lines. From this the paper is to be printed, say of a light blue, pink, &c. The standing words may then be printed of another colour by any of the known methods. Should chemical means be resorted to for the removal of the fine ground, no human ingenuity, it is said, will suffice to restore and re-unite the lines; and to transfer the two kinds of printing lithographically, will be equally impracticable. When used without the printing of standing words, any erasure on the fine ground will be perfectly apparent.

"The invention consists in the prepared ground covering of paper to be used for securities written in whole or in part, with or without standing words in the same, of different colour from such ground, substantially as above described."

49. For a *Brick Machine;* T. Miles Bannister, Phelps, Ontario county, New York, June 19.

This is said to be an improvement on the machine called "Rising's Columbian Brick Maker," which, it seems, was a common pug mill for mixing the clay, the tub in which the vertical shaft, with its knives, revolved, being cylindrical.

"What I claim to have invented as an improvement on Rising's machine, is the tub or cylinder being larger at the bottom than at the top; the circular scrapers attached to the bottom of the shaft, the two pistons, and the manner of working them; the moulds, the manner of working them, and the mode of casting them off to right and left by means of a lever."

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50. For *Pistons for Steam Engines:* Benjamin Wright and George Kitchen, Calhoun county, Michigan Territory, June 19.

This is a worthless contrivance, lamely described. The piston is to have six, or any other number of vertical rods extending from one head of it to the other, and between each of these there is to be a bellied friction roller, so as to form a circle of them fitting the cylinder, to take off friction. The other part of the piston is to be packed with hemp, or cork.

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51. For a *Mortise Lock and Latch;* John G. Hotchkins, New Haven, Connecticut, June 19.

This is a kind of lock, or latch, somewhat similar to several which have been patented within a few years, excepting that before us is claimed to be new in the forming of the case and tumbler as described. To ascertain the peculiar difference between this and some others, would require more time than we can bestow upon the subject. The drawing does not make this point clear, for although it is good enough as a picture, it gives no sections, makes but three references, and that to parts partially obscured.

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52. For an improved mode of *Fixing Tubes in Steam Boilers;* John Goulding, Boston, Massachusetts, June 19.

The tubes for the passage of heated air, or water, which pass from head to head, or from one part of a steam boiler to another, are to have tapering male screws cut on each end; one of these is to be larger in diameter than the other, so that the smaller screw at one end, and the tube also, may pass through the hole made for the larger screw. The larger end may be upset, or increased in size in any other way. The screws are to be tapering, and must be cut with such truth that they will enter and tighten up at the same time. The claim is to this mode of inserting tubes.

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53. For a *Machine for Boarding and Softening Skins;* Eli Kendall, Ashby, Middlesex county, Massachusetts, June 19.

The mode of softening skins which has been hitherto followed, is to rub them with an instrument consisting of a board faced with cork, and having a strap across the back, in which to insert the hand. In the machine before us, there is a sort of rubbing board, the lower side of which acts upon the whole skin at once, it being doubled, with its polished side inwards. We cannot, without the drawing, give a full description of the machine, and it is not, in fact, very clearly illustrated. There is no claim made, the

whole machine being considered as new. We are told that, by its means, one man can perform what has been accounted the work of three.

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54. For a *Portable Boiler;* Anson W. Spenser, Cazenovia, Madison county, New York, June 19.

Boilers are generally made with the design of saving heat, but that before us is well adapted to the wasting of it, which it will do most effectually. The drawing represents a boiler something like a coffee pot, but with the smaller end downwards. An interior fire tube runs from bottom to top, perforating both, so that there may be an ash pit below, and that the draught may be increased by adding a pipe on the top. The fluid is, of course, to surround the fire. Of what use the thing is to be we are not told, nor will this soon be discovered.

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55. For a *Machine for Cutting Grass;* Isaac Sturdevant, of Portland, and John Holmes, of Harrison, Cumberland county, Maine, June 19.

Four scythes are to be made to revolve horizontally on a vertical shaft, by gearing from the wheel axles. The general plan is one of the most common for such machines, is imperfectly described and drawn, and there is no claim made.

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56. For a *Machine for Planting Cotton;* Jordan Gatling, Murfreesborough, Hertford county, North Carolina, June 19.

Machines for planting seeds are very numerous; the one before us consists of the various apparatus for opening the ground, dropping the seed, and closing the furrows, and differs but little from others. The claim is to that part of the machine which performs the operation of distributing the portions of seed intended to be dropped from the first hopper to the second, and consists of the combination formed by the slide board attached, as described, to the hopper and moved from side to side by the shaft suspended from the brace by the eye, and working with the slide board by means of the pivot, or pin: also, the use of the second hopper below, adjusted with the hole through the beam.

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57. For a *Smut Mill;* John Card, Gainsville, Gennesee county, New York, June 20.

The patentee denominates this an "Elastic, Accelerating, Smut Mill," and furnishes a description of much length and particularity. A vertical shaft is to carry a cylindrical rubber, which may be two feet four inches high, fifteen inches diameter at top, and eighteen at bottom. This is to be surrounded by a stationary sheet iron case, punched from the outside so as to constitute it a concave rubber. The inner, or revolving, cylinder is also to be converted into a grater by covering the ends with punched sheet-iron, and the sides with strips of leather, into which nails, or tacks, are driven from the inside, so as to form a kind of elastic card. Instead of this, however, it is proposed sometimes to cover the outside with pointed cast-iron staves; the term "elastic" will, in this case, not very aptly apply.

"What I claim as my own invention, and not previously known, in the above described machine, is the manner of constructing the cylinder in the two different ways herein above specified, together with the principles of the operation of said machine, it requiring less power to propel it, and being

used with greater safety, being less liable to generate heat, than any machine of the kind before known or used. I also claim as my invention, the manner of constructing the concave hereinbefore mentioned."

The machine is, substantially, so like a host of others that it would be no easy task to make out a claim which should not be too broad.

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58. For a *Stove;* James Atwater, New Haven, Connecticut, June 20.

We are told by the patentee that "this improvement consists in certain alterations of, and additions to, a common furnace stove used to burn hard coal, for the purpose of retaining and diffusing the heat of the fuel burned therein in a convenient and economical manner."

Those who are acquainted with the construction of Spoor's parlour stove, (see vol. 16, p. 81,) will easily understand Mr. Atwater's, as it is precisely the same thing, changed only in form. The furnace part is the common cylindrical stove, with the four flues of Spoor's stove, forming four separate columns, the stove and columns extending from a quadrangular base containing the ash pit, and side flues, to a quadrangular cap, or entablature properly divided, and supplied with slides or dampers to cause the heat to circulate down the front and up the back columns, or to admit it directly to the escape pipe.

The patentee disclaims the invention of the individual parts, but claims as new "the above described combination and arrangement to accomplish the above mentioned purposes."

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59. For a machine for *Mixing Mortar and Pulverizing Clay;* John Everhart, Waynesville, Ohio, and Lewis Swimley, Washington city, D. C., June 20.

We have before us, in Rees' Cyclopedia, a very perfect description of the machine here patented; it is there described as it was used seventy or eighty years since, but had then no claim to novelty, its construction and use being of remote antiquity. See the article *Pottery*, Rees' Cyclopedia, vol. 29.—We shall only copy enough from Rees, fully to supply the place of this *new* specification.

"The clay is thrown into a cylinder of cast metal, four feet high and twenty inches in diameter. In the middle of this cylinder runs a perpendicular shaft with knives as radii at right angles to the shaft. These knives are so arranged upon the shaft that their flat sides are in the plane of a spiral thread, so that by the revolution of the shaft the knives do not only cut every thing in their way, but constantly force downward what may be in the cylinder, agreeably to the nature of the screw; another set of knives is inserted in the interior of the cylinder, and extends to the shafts in the centre."

The only consolation we can offer to the patentees is that they are not alone in their disappointment, the same kind of machine having been repeatedly made the subject of a patent by other pretended, or imaginary, inventors.

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60. For a machine for *Pressing Brick;* Wm. Wadsworth, Hartford, Connecticut, June 20.

This improvement is said to consist in a combination of machinery to effect a new purpose; the respective parts of which machinery may all have been individually used for the same or other purposes.

It is a toggle joint press, bearing a very considerable resemblance to other toggle joint presses, which have been employed for the same purpose.

We do not think that its new arrangements are so characteristic as to "distinguish it from all other things before known or used," without some specific pointing out of its novelties.

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61. For a *Cooking Stove;* Le Grand Fairman, Medina, Orleans county, New York, June 26.

There is not any thing special in this stove, entitling it to particular notice. It is to have two ovens, one on each side, and any required number of openings in the top plate to receive cooking utensils, or dampers to direct and regulate the heat.

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62. For *Portable Ovens, or Cooking Stoves;* Charles Vale, Newark, Essex county, New Jersey, June 26.

There appears to be but little novelty about this stove, excepting in the name given to it at the end of the claim, which is as follows: "The parts I claim as my invention, and not known, in the above portable ovens, are the particular construction of the fireplace, which only allows one-third of the fuel it will contain to be ignited at one time, and cause that to be regular as long as there is that quantity in it. The double shelves, and the manner of conducting the smoke and heat over the whole surface of them, by which so much fuel is saved, and from which I call it the *Chaloric* Extractor."

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63. For a *Machine for Cutting Straw;* James M'Math, Meadtown, Crawford county, Pennsylvania, June 26.

"What I claim as my invention, and not previously known in the above described machine is the so affixing the knives to the gate, or slide, that they will follow each other at a distance just sufficient to allow the first to have passed through, or nearly through, the material to be cut, before this second comes in contact with it, and so on according to the number of knives used; and by giving a degree of length to the gate, or slide, and also of length to the lever, by one stroke of the lever the whole number of knives shall each in succession have passed through the straw."

It is calculated that by such a machine, four times the work may be performed, "with little, if any, additional power."

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64. For a machine for *Felling Trees;* James Hamilton, city of New York, June 26.

The patentee, after describing the construction of his machine, says, "this applicant in the next place describes the principle of his invention, as follows. It consists of the combination of a horizontal saw with a crank movement, the saw being of any convenient length, but in the shape of a small segment of a circle, and the length of the crank with which it is directly connected being sufficient for the length of the intended stroke of the saw, the saw being fixed in a frame, and this moving in a centre fixed in another movable frame which is connected with and movable upon the same centre as that of the crank; this frame having a horizontal circular movement upon a roller, by force of a weight acting over a pulley, so as to bear the saw forcibly against the material to be sawed, the crank being made to act by any convenient mechanical motion, the whole operating so as to saw horizontally, it being designed for felling trees by sawing through the trunk of a tree horizontally, and near the ground."

Mechanical saws of this description have their uses, as for cutting off piles under water, &c., but they will never enter into competition with the axe of

the American woodman; and we are well convinced that in an attempt to use them in this way, his aid would not unfrequently be required to extricate the saw from the kerf in which it would become pinched.

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65. For a *Corn Shelling machine;* John C. Dunbar, Temple, Kennebec county, and Addison Powers, Carthage, Oxford county, Maine, June 26.

This is the most old fashioned, because it is the first fashion, of shelling machines, but the patentees propose to make the concave of three separate pieces of sheet-iron, and to perforate them like a grate.

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66. For a *Cooking Stove;* Thomas D. Burrell, Geneva, Ontario county, New York, June 26.

In the description of this Cooking Stove there are several things mentioned which are omitted in the drawing; such, for example, as openings for kettles, doors, &c. &c. The lower part of the stove, which is to contain the fuel, is represented in the form of a very low Franklin. The two upper plates of this, making part of the flues, extend far back, and from them two other plates run vertically to the height of two feet, forming a semicylindrical flue, eighteen inches in diameter within. The upper end of this also is double, and from it rises the smoke pipe.

A semicircular tin reflector is to be placed against this semicircular recess, and converts it into an oven, eighteen inches in diameter, and two feet in height. A vertical shaft within this, furnished with open, horizontal shelves, called a revolving reel, is to sustain the articles to be baked.

The claim is to "the oven formed by the flattened upright flue and covering; the upright revolving reel, and the combination of the door and openings in front, for the uses set forth." Which latter part, with its combination, we are left to guess at, it being entirely omitted in the drawing.

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67. For a *Napping Machine;* Reuben Daniels, Woodstock, Windsor county, Vermont, June 26.

This machine is intended for the narrow kinds of cloth. The napping cylinder is made about nine inches and a quarter in diameter, and about three feet in length. The surface consists of twenty-six lags, or strips, allowing a space between each for needles to pass in and out. The napping cylinder is hollow, and has a cylindrical shaft through its centre, upon which is fitted the necessary apparatus for projecting or retracting the needle points. This apparatus is governed by screws at the end of the cylinders. The needles are fixed on metallic plates very near together, so as to stand like the teeth of a comb. This cylinder may be so placed as to operate like the ordinary teazling machine, but its motion must be much slower.

What is claimed "is the principle, or improvement of varying, gauging, or graduating, the projection of the needles, wires or teeth, which are designed to do the work, performed by teazles in the common teazling machine."

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68. For a *Rotary Steam Engine;* Orson Baines, Van Buren, Onondaga county, New York, June 26.

This is another machine to blow away steam to little good purpose. A hollow gudgeon is to carry steam into a hollow revolving drum from two points on the edge of which it is to escape.

"Now what I claim as my own invention and not previously known, in

the above described machine, is the discharging of the steam on the outside of the rim of a tight enclosed circular wheel, at the greatest possible distance from the axis, or shaft, by which an increase of power is gained over any other rotary engine," &c. &c.

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69. For improvements in the *Loom for Figured Work;* E. Meily, jr. and J. & S. Mellinger, Lebanon, Lebanon county, Pennsylvania: first patented March 1st, 1834. Reissued under an amended specification, June 26.

The description and drawing of this machine under which the first patent was issued, were altogether defective, and although it has been intended to remedy these defects by the amended specification and drawing, the latter are so constantly, and necessarily, referred to in the former, as to render them inseparable. We think the improvements valuable for the purposes to which they are applied; but all that we can now do towards giving an idea of them is to insert the claim, however inadequate this may be.

"We claim as our invention the general arrangement of the parts connected with the round and oval wheels, as herein described, for the purpose of operating upon the needle shaft in the manner and for the purposes set forth. We claim this manner of carrying out the pattern cards by means of friction rollers, and the steadying the same by means of a loose roller in the doubling thereof. We also claim the mode described of preparing the pattern cards upon a block of wood, by means of a hollow punch and clearer, operated upon by a spring."

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70. For *Riding Saddles;* A. L. Van Horn, City of Philadelphia, June 26. (See Specification.)

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71. For a *Machine for Hulling Clover Seed;* John Whiteman, City of Philadelphia, June 26.

The seed to be hulled is put into a hopper which narrows down so as to leave a longitudinal opening through which the feeding is affected by means of a fluted revolving roller. The hulling is effected by means of revolving, metallic disks, or wheels, five or six inches in diameter, fluted, or grooved, at each side and on the edges. These are placed upon two shafts, standing in the same horizontal plane, the disks on one shaft standing between those on the other, and just clearing each other and the shaft, so as to admit the seeds to pass without being crushed. Any number of disks, of which the size of the machine admits, may be placed on each shaft. The disks revolve towards each other, and the feeding takes place in the centre between them. A comb-shaped board on each side prevents the seed from escaping outside of the disks.

The claim is to a machine so arranged and constructed as that a new hulling machine is thereby formed.

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72. For a *Rotary Steam Engine;* Charles Hill, Zanesville, Muskingum county, Ohio, June 26.

To understand the whole of the references made in the claim would require a drawing, and as our confidence in the Rotary Steam Engine is small, and our objections will yield to the omnipotence of success only, we wait the arrival of such a proof. This is one of the reaction engines, and the claim is to "the principle of increasing the surface of reaction, and diminishing the

motion, without diminishing the power of the steam; which is effected by the enlargement of the steam pipes, (as at D, D,) and the vacuum created by the condensation of the steam, giving a less velocity to the wheel, accompanied by a corresponding increase of power. I also claim as my invention the introduction of water and air, either separately or in connexion, for the purpose of creating the vacuum, and the manner of introducing and disposing of the same; together with the manner of disposing of the steam so as to assist in maintaining the vacuum. I claim as my invention the application of these principles, to attain the objects herein set forth, whether the same be effected in the precise manner described, or otherwise."

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73. For *Ever Pointed Pencil Cases;* Ellwood Mears, City of Philadelphia, June 26.

The improvement consists in the manner of forcing the lead out of the metal point, and is as follows. The slide, or band, which moves up and down the stick, is also capable of a circular motion around it. This slide, or band, has on its inner surface a screw thread, into which the nut of the pin, or wire, used in propelling the lead from the point, works. The band or slide is kept in its place, and pushes out this metallic point by means of two small screws fastened to the lead groove within the case, and rising on each end of the band. Thus by holding the case in one hand and turning the slide or band to the left, or, if preferred, by retaining the slide so as to be immovable, and turning the case to the right, the lead can easily and quickly be propelled from the metallic point.

"What I claim as my own invention, is the method of using the band, or slide in forcing the lead out of the metal point, instead of the complicated works heretofore in use."

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74. For a *Churn;* Isaac Wood, Connelsville, Fayette county, Indiana, June 26.

There is an oval tub, through the sides of which a shaft is to pass, having a winch at one end by which it may be turned. The shaft must revolve in a water tight joint, and is to carry a number of arms or dashers, of such length as the tub will admit.

There is not any claim made, and, excepting in the shape of the tub, which does not offer any very apparent advantages, there is scarcely any difference between this churn and many others.

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75. For a *Mill for Grain, &c.;* William S. Johnson, City of New York, June 26.

The patentee calls this an "eccentric mill," and proposes it as proper for grinding paints, dye stuffs, snuff, and most other articles required to be ground. A sufficient description of it may be found at p. 34, Vol. 10, as patented by James Bogardus, of the City of New York, the difference between that and the one now before us being, most manifestly, colorable only. We should think it certain that if the claim of Mr. Bogardus was well founded, the present is an invasion of it.

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76. For a *Machine for Planting Corn;* Thomas D. Burrall, Geneva, Ontario County, New York, June 26.

After describing this seeding machine the patentee very truly says, "now in the above description there is perhaps no one part which is new in itself;"

and to this he adds: "But what I claim as my invention is the combination of the several parts above described, forming collectively a convenient and useful implement for furrowing, planting, covering, and rolling, at a single operation."

This sort of claim, to combination and arrangement, has become a kind of universal salvo where nothing new is to be found in the machine patented, but it will not answer; where there is real novelty in an invention, and it consists, as is most commonly the case, in combination and arrangement, it is as susceptible of being distinctly pointed out as novelty of any other sort: in the case before us, it is true, the task would have been a hard one.

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77. For an improvement in *Roofing Houses with Tin, Copper, and Zinc;* John Bouis, Baltimore, Maryland, June 26.

This improvement is very imperfectly described; the apparatus used for bending the edges of the plates is not well represented, nor is any thing particularly pointed out as forming the foundation of a claim. All that we can collect of any peculiarity is that "the grooves or edges of the groove roofing being made in a semicircular form, instead of an angle as formerly constructed, give the metal a better chance to expand or contract without the danger of cracking, and also form a gutter to carry off the water and dirt, without obstruction." There are no instructions given for fastening the roofing; we conclude, therefore, that there is not any thing new in this.

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78. For *Flasks for Moulding Iron Tea-kettles;* David Stewart, Danville, Columbia County, Pennsylvania, June 26. (See Specification.)

Specifications of American Patents.

Specification of a Patent for an improvement in Riding Saddles. Granted to A. L. Van Horn, *City of Philadelphia, June 26th,* 1835.

To all whom it may concern, be it known, that I, A. L. Van Horn, of the City of Philadelphia, have invented an improvement in the manner of making Riding Saddles of all descriptions, and that the following is a full and exact description thereof.

The saddle need not in its general construction be in any way altered from that now pursued by the manufacturers of that article. The saddle tree, the irons, the mode of covering, and in fact all the parts may be the same with those now employed by different workmen, my improvements consisting solely in the substituting webbing, or girth, of the kind denominated India Rubber Webbing, for that which is usually strained upon the saddle tree, and which forms the foundation for the seat. The India Rubber Webbing is a well known article, consisting in part of that substance interwoven with the ordinary materials of webbing, and communicating to it great elasticity, and that in a degree peculiarly adapting it to the new purpose to which I have applied it. In order to derive all the advantage possible from the use of this webbing, I take care in straining it to draw it as high upon the cantle as possible, as by this means it will have sufficient play without descending so low as to come in contact with the back of the horse, or with the saddle tree.

A. L. Van Horn.

Specification of a Patent for an Improvement in Flasks for Moulding Iron Tea Kettles, and other vessels of a similar nature. Granted to DAVID STEWART, *Danville, Columbia County, Pennsylvania, June 26th*, 1835.

To all whom it may concern, be it known, that I, David Stewart, of Danville, in the County of Columbia, and State of Pennsylvania, have invented an improved mode of constructing Flasks for the moulding of Cast Iron Tea Kettles, by which the number of parts of which they ordinarily consist is reduced from four to two, and the necessity of turning the flask over in the operation of moulding is altogether obviated, and I do hereby declare that the following is a full and exact description thereof.

I use a mould board of cast iron, upon which the pattern and flask are to be placed. The mould board has a circular excavation, or gutter, around its centre, which is to be filled with casting sand, upon which that part of the pattern rests which forms the rim, of the opening in the top of the kettle, which part would otherwise be chilled by the mould board in casting. The pattern for the kettle is in the usual form, and has a square shank rising from the centre of that part which forms the opening for the lid, which shank fits into a square hole in the centre of the iron mould board, when the pattern is placed upon it for moulding.

The flask consists of two parts only, dividing horizontally immediately opposite the swell of the kettle, and the upper part extending a sufficient height above the bottom of the kettle for the requisite thickness of sand. The pattern being put into its proper place is surrounded by the lower half of the flask, and this is filled with the sand to a level; the upper half of the flask is then placed on, and the moulding of the outside completed, when the upper flask may be taken off, and the pattern removed. The manner of moulding the spout does not differ from that ordinarily pursued.

The mould for making the core, and the manner of filling it differs from that heretofore followed, the core mould being filled from the part which forms the bottom, instead of that which forms the top of the kettle. A mould board is prepared having a hole in its centre of the same size with that in the iron mould board, and into this the shank of the anchor, which is to sustain the core, is placed, and that half of the mould which corresponds with the top of the kettle is passed over it, and secured in its place. The other half of the core mould is then put on, and the whole is filled with sand, properly rammed in. In order to fill it, the core mould has a suitable opening, or openings in the part which is uppermost, and which corresponds with the bottom of the kettle, and when this is properly filled, and the core pierced for air holes, it is ready to be removed to the iron mould board, and anchored in its proper place.

What I claim as my invention, and wish to secure by letters patent, is the particular manner of constructing the flasks as described, in two parts only, for the moulding of tea kettles, and other articles of a similar form; the employment of the iron mould board; and the formation of the core in a separate box, or pattern, charged with sand at the bottom, and adapted in the way described to the anchor, which is to be placed on the mould board without the necessity of inverting, or being obliged in any way to raise or remove the same, in the operation of moulding. I also claim the application of the same principles of moulding to all kinds of hollow ware, which is swelled, or bellied, in the manner of tea kettles, varying the procedure in such a way as will be evident to every competent workman, so as to adapt it to the particular kind of vessel intended to be cast.

DAVID STEWART.

Specification of a Patent for an improved machine for the purpose of Cutting Sausage Meat, and of Stuffing Sausages. Granted to ABRAHAM KEAGY, *of Bradford County, and* JOHN KEAGY, *of Franklin County, Pennsylvania, June 15th,* 1835.

The cutting is effected by means of a cylinder, around which are placed knives which we usually make of a triangular form, one of the sides being in contact with the cylinder. This revolves within a concave, or hollow cylinder, furnished with similar knives so placed as not to interfere with those on the cylinder. These knives are but placed somewhat obliquely, so as to stand in the direction of a spiral around the cylinders. The revolving cylinder has its axis placed horizontally in a box, the sides and ends of which are enclosed excepting where the meat is admitted and discharged. A gudgeon projects through the box at one end to receive a crank or wheel to turn the cylinder.

The opening for feeding is on the upper side, and at one end of this box; and this opening is surmounted by a vertical trunk, which may be in the form of a parallelogram, of the width of the lower box, and about half its depth, more or less. A piston, or follower, is adapted to this feeding trunk, or hopper, from the middle of which a rod rises, operating as a piston rod, being acted upon by a lever, worked like a pump handle. The piston rod passes through the lever, and has a rack, or notches, upon it, which engage with the lever in its descent, but allow it to rise without raising the piston, so that the meat put into the feeding trunk is forced down by each successive stroke. To facilitate the passage of the meat into the horizontal, from the vertical trunk, I form a spiral excavation in the hollow cylinder, immediately under the vertical trunk; which operates as an inclined plane in producing the desired effect. The cut meat, when it arrives at the extreme end of the cutting cylinder passes out through an opening in the bottom of the box. When the feeding trunk is to be replenished, the lever may be turned back on its joint, and the piston removed, leaving the opening perfectly free.

When the cutting has been completed, the vertical trunk, with its piston, is used for the purpose of stuffing. To effect this, a shutter, or slider, is slipped into its place where it forms a bottom to the vertical, and cuts off its communication with the horizontal, trunk, and a tin, or other tube, of proper size, is fitted into an opening prepared for it on one side of the trunk, at its lower end, upon this tube the entrail to be stuffed is gathered, in the usual way.

To allow the escape of air, this latter tube has a small tube, or opening, soldered on its outside, from end to end. This opening may be semicircular, so as to make but a slight projection on the stuffing tube. The effect of this will be obvious.

We have not thought it requisite to give the dimensions of the respective parts, as they will vary according to convenience, and will depend upon the power to be applied, and the quantity to be cut. One thing, however is essential, namely, that the length and size of the cylinders, and the number of knives, be proportioned to the quantity to be cut; but this can be regulated also by the pressure made upon the piston.

We do not claim as our invention, the individual parts of the above described apparatus, but what we do claim is the general combination and arrangement of the respective parts, as herein set forth, for producing the required effect. Not intending, however, to confine ourselves to the exact form given, but to vary the same in any way, whilst the same results are produced by analogous means.

ABRAHAM KEAGY,
JOHN KEAGY.

Specification of a Patent for Washing Clothes, and for Churning. Granted to CHARLES OTIS, *of Finksburg, in the County of Baltimore, and State of Maryland, June 15th,* 1835.

I make a revolving cylinder, or barrel, which is to turn upon gudgeons in the usual way, and having an opening through which the articles to be acted upon may be introduced, and secured by a close fitting door, or shutter. I cause this barrel, or cylinder, to revolve in a trough which serves to catch any suds that may be allowed to escape, and which, in the churning of butter may be filled with water, either warm or cold, according to the season of the year, and thus facilitate the operation. The parts thus far described I do not claim as constituting any part of my invention, the same having been repeatedly constructed by others; but what I do claim is the following appendage within the revolving cylinders. I place flat wings, or buckets, on the inside of the periphery of the cylinder, extending along from end to end; of these there may be two, three, or more, made of flat boards, the planes of which stand in the direction of radii to the cylinder. These boards may vary in width from two to six inches, more or less, according to the size of the machine, and I sometimes perforate them with holes, to increase the agitation of the fluid. They also serve to lift the clothes and suds in washing, or the cream in churning, more effectually than the pins which have sometimes been employed for that purpose. I confine my claim exclusively to the employment of the wings, or buckets, herein described. C. OTIS.

Progress of Theoretical and Practical Mechanics.

Report on the use of the Hot Air Blast in iron Furnaces and Foundries. By A. GUENYVEAU, *Engineer and Professor in the Royal School of Mines.**

(Translated for this Journal, by Professor A. D. Bache.†)

This report embraces the observations made during a tour of examination of the furnaces and foundries in the south of France, in some of which the hot air blast is used. The tour was undertaken by order of the director-general of bridges and roads, and of mines.

In remarks upon the subject, a distinction must be made between the furnaces where coal is used and those which use charcoal. The amount of air required is so different in the two classes, being sometimes as two or three to one, that the apparatus for heating it is usually different. The results are, however, nearly the same for both classes. All the furnaces examined use ores from the same part of France. The hot air blast has succeeded best in the furnaces of Vienne (Isere), the two at Terre-Noire (near St. Etienne), and those of the Voulte (Ardeche.)

In one furnace, that of Firmy (Aveyron), the results with this blast were not satisfactory, either with raw coal or with coke. The large establishments of Creusot and Alais, and those of l'Orme (Loire), have not yet applied heated air. The fuel used in them is coke. At the furnace near Torteron, where the fuel is a mixture of charcoal and coke, the hot air blast has been used to advantage, in regard to the quality of the iron. In the various smelting furnaces in Burgundy and Franche-Comté, where charcoal is used as a fuel, the new process has proved satisfactory.

* Annales des Mines, vol. vii. Livraison 1.

† This is a translation of extracts from the report of M. Guenyveau, and in parts where the details do not seem to be of special interest, an abstract of his results.

I. Heating Apparatus.

Of these there are various forms in use. The objects sought are economy in heating the air, a sufficiently high temperature, and the preservation of the pipes. The apparatus used at Calder* (Scotland) appears to answer the best purpose. It is in use at Vienne, and in one of the Firmy furnaces. The first apparatus put up was like that used at the Clyde† furnaces; this is still used at Torteron and la Voulte, but has, at Vienne, given place to the Calder apparatus. The heating pipes are two inches in diameter, and at Firmy have been replaced by others two and a half inches in diameter. It might seem that these pipes are too small, but experience has sanctioned their use. It is not known how long this apparatus will last; in fact the duration must depend upon the temperature to which the pipes are heated, and upon the nature of the coal. It is believed that the arrangement with highly inclined tubes will outlast that with horizontal ones. The temperature of the air is easily raised above the melting point of lead (604° Fahr.) The cost of the apparatus for each tuyere is about 1200 francs ($240.)

The flame which appears at the trunnel head of smelting furnaces which use coke, has not been applied to heat the blast, although it has been advantageously applied in charcoal furnaces. It would seem that this mode of heating should apply particularly to furnaces in which raw coal is used, on account of the amount of unconsumed combustible matter which issues from the trunnel head; notwithstanding which, M. Dufrenoy gives one case, in the neighbourhood of Birmingham,‡ in which the heating apparatus placed upon the platform of the furnace did not answer the purpose. The temperature of the air could not be raised above 360° Fahr., and subsequently it was heated by a separate furnace which consumed four tons of coal for each ton of iron. As, however, the temperature to which the air is heated at the Voulte furnace is below that just stated, the question cannot be considered as decided.

The air blast is generally heated above melting point of tin (442° Fahr.), and sometimes above that of lead (604° Fahr.), and even higher. In other furnaces, as at the Voulte and Torteron, where horizontal heating pipes are used, the temperature has been diminished, in order to save the wear of the pipes. At the first mentioned furnace it never exceeds 340° Fahr., being at a mean about 320°, and at the second never exceeds the melting point of tin. At the furnaces of Terre-Noire the heat is carried by Taylor's§ apparatus to 572° Fahr. It has been said that the advantages of the hot air blast increase in the ratio of the temperature of the blast, an assertion which, although it appears probable, and has been confirmed by certain observations, is not true in all cases. At the Voulte the results were sensibly the same where the air was heated to 428° and to 320°.‖

Several methods have been used to determine the temperature of the hot air blast. One was to use a common thermometer, with a metal scale; the bulb being inserted into the blast pipe near the nozzle. Another method was to use a slip of lead, tin, or of some fusible alloy, according to the tem-

* See this Journal, vol. xv. p. 213, pl. 2, figs. 6, 7, 8 and 9.

† Ibid. vol. xv. p. 209, pl. 2, figs. 1 and 2.

‡ See this Journal, vol. xv. p. 272, pl. 3, figs. 15 and 16.

§ Similar to that described by M. Dufrenoy, vol. xv. p. 213.

‖ It may readily be understood why an increase of 100° from 320° to 420° should not produce so sensible an effect as from 220° to 320°, or as from 120° to 220°.—Translator.

perature, which was exposed to the air issuing from a hole in the blast pipe.* At Torteron the alloy was two-thirds tin to one-third of lead.

Great inconvenience has been felt from the leakage of the pipes used in the heating apparatus. These leaks when they occur in the heating ovens are only discovered by a deficiency in the yield of the furnace. They occur commonly at the joints, and the liability to them increases with the increased temperature of the blast. The repairs which are necessary alter the supply of air, and thus derange the system of working.

It is a desideratum to render the leakage less common and the means of repair more easy. When these leaks occur, if the fire is not immediately extinguished, the pipes being no longer kept cool by the air passing through them, burn out very quickly. The heating apparatus placed near the trunnel head is free from this defect.†

The effect of these difficulties has merely been to produce a resort to the reduction of temperature noticed at the furnaces of La Voulte and Torteron. The remarks of M. Dufrenoy on the forms of apparatus, confirmed as they are by extensive observation, deserve great attention.

The effects of heating the air upon the quantity and pressure of that passed into the furnace may be thus estimated. If we suppose the air heated from 60° to 568° Fahr. its bulk will be doubled and consequently, under the same pressure, but half the quantity will pass through a given orifice, which would have passed had the air not been heated. Generally, until the area or nozzle of the blast pipe is nearly doubled, the advantage of the hot air blast is not realized. Before this change in the nozzle, the furnace is not duly supplied with air. Besides, the pressure at the tuyere has been observed to diminish with a given pressure at the blowing machine, a fact which may be explained by the resistance of the air moving through the pipes of the heating apparatus, the elbows in which tend to make the resistance quite considerable in amount.

If then the pressure and the quantity of air thrown into the furnace should be the same with the hot and cold blast, the power of the blowing machine must be increased. This has not been found necessary in the English works, where on the contrary they have supplied more furnaces with heated air by the same blowing machine, than could be supplied with cold air. Less fuel being consumed in a given time, with a greater yield of metal, less air is required to support the combustion. In these works the power required to supply heated air is estimated at one-tenth more than that employed for the cold blast, for the same weight of ore, but as the weight of the air thrown in is diminished one-fourth, the same blowing machine which supplied three furnaces with cold air will supply four with the hot blast.

At the Calder furnaces (Scotland,) the pressure of the hot air blast was less than that of the cold air previously used by two-thirteenths, and at the Clyde works by one-sixth. M. Varin estimates the economy from this source at la Voulte works at one-fifth, the pressure being reduced from three inches and a quarter of mercury to two inches and a half.

At the Torteron furnace where the heated air blast has neither changed sensibly the amount of fuel used, nor of iron produced, the blowing machine requires a little more fuel to produce the steam required to move it, than it did when cold air was used. At Wasseralfingen where the consumption of charcoal has not varied materially by the change from the cold to the

* By reference to this Journal, p. 74, vol. xvi. a more convenient method of using the thermometer will be found.—Translator.

† If so, it would seem that it must be deficient in heating power.—Translator.

hot air blast, they require more power with the latter, a larger quantity of air being necessary in running the furnace. It is not said that the dimensions of the blast pipe nozzle have been changed. At Ancy-le-Franc in August, 1834, the pressure at the governor remaining constant, that at the tuyere was observed to fall to one-half, when the air was heated. The size of the nozzle was increased, but there was not an adequate power to supply the air required, and the yield of the furnace diminished.

Tuyeres, cooled by water, have been substituted for the ordinary ones in furnaces using the heated air blast; the cooling effect of the blast being taken away, the ordinary tuyere is rapidly burned out. Cast-iron water tuyeres have been found to last longer than those of wrought iron; they wear out in from three to six months.

In many establishments the blast pipe nozzle is permanently attached to the tuyere, an arrangement which answers well when it is not necessary to clean out the tuyeres. When this is necessary, the common arrangement is to be preferred, and this is generally the case in the French works even where charcoal is used.

When the nozzle is not closely fitted to the tuyere, the blast is slightly cooled before it gets into the furnace, and part of it does not pass in.

II. On the effects and advantages of the Hot Air Blast.

The effect appears to be to increase the heat within the furnace, so that a refractory ore is fused; any stoppage in the furnace is prevented, and the working is more readily resumed after the furnace has been cooled. Less fusible ores may be used, less flux is required for their reduction, the slags are more fusible, and become spongy if water is thrown upon them when incandescent. This property has been observed only in the Styrian furnaces and others where charcoal is used as a fuel, and the ore is a manganesian carbonate of iron. Further, grey pig iron is obtained with every kind of ore, this variety of iron requiring a high temperature for its production. Generally the heated air and combustible gases which issue from the trunnel head, are diminished in quantity and the heat is more concentrated in the lower parts of the furnace; a source of great advantage, but which causes a more rapid destruction of the hearth and boshes.

The working of the furnace when heated air is used is comparatively easy, there are fewer cases of clogging and they are readily remedied; the tuyeres are almost always free, no slag collecting and hardening about them. Frequently, a clogging in the furnace may be removed by raising the temperature of the blast. The advantages may be succinctly enumerated as follows.

1. A change in the iron which becomes more grey, and even black, and the slag is more fluid than when cold air is used.

2. An increase in the quantity of ore which a given weight of fuel will bear, whence results a diminution in the quantity of fuel required to produce a ton of metal, after the fuel required to heat the air has been taken into account.

3. A diminution in the quantity of flux, to which there are, however, exceptions.

4. An increase in the daily yield of a furnace.

We do not enumerate among the advantages that of using crude coal, because it has been ascertained both in Wales and at Decazeville, that this may be done with the cold air blast.

In regard to the quality of the iron produced by the hot air blast, the following facts have been collected.

It has been asserted that iron, thus obtained, requires to be remelted when it becomes duly tenacious, and yet the Lyonese founders complain that the iron of Vienne is weak. On the other hand, iron from the Torteron furnace was cast into shells which required more powder to burst them than similar ones made from iron procured by the cold blast, the strength having been nearly double, in the former case, of that in the latter.

In England there appears to have been no sensible difference between the castings made from iron obtained by the two different methods.

The same uncertainty prevails in regard to the forged iron obtained from pigs reduced by the aid of the hot air blast. M. Dufrenoy and M. Debilly, consider the notions prevalent on this subject in England, to be founded in prejudice. My observations in the South of France have shown that there is, if any, a very slight difference in the quality of the iron in favour of that made by the cold blast. At one of the furnaces it was suggested that silicious ores gave a worse iron by this process than by the cold air blast, the great heat facilitating the union of the silicium with the carbon and iron. A careful analysis is required to demonstrate this theory, in favour of the probability of which it may be stated that at Firmy, where a very silicious ore is used, the iron made by the hot air blast is worse than that by the other process, and when refined, produces a worse malleable iron. It is remarkable, moreover, that the best iron is obtained when the ore is in excess in charging the furnace, in which case the iron is reduced at the lowest temperature.

[TO BE CONTINUED IN OUR NEXT.]

Composition and specific gravity of different kinds of Glass.

Ordinary flint-glass, according to Mr. Faraday's analysis, consists, in 100 parts, of silica 51.93, oxide of lead 33.28, potash 13.77, with minute portions of other substances. A specimen of the same kind of glass, manufactured for telescopes by the late M. Guinand, yielded the same chemist, silica 44.3, oxide of lead 43.05, and potash 11.75. Mr. Faraday found the specific gravity of M. Guinand's glass to be about 3.616, that of ordinary flint-glass 3.290, that of plate-glass 2.5257, and that of crown glass 2.5448.

Glass has usually been considered, without much actual inquiry into the subject, to be strictly a chemical combination of its ingredients, and in all respects a very perfect artificial compound. This, however, is far from being the truth, as will appear from the following facts. That the alkali in common glass of all kinds is in a very imperfect state of combination, many circumstances concur to evince. For example, Mr. Griffiths has shown, that if a small quantity either of flint-glass, or of plate-glass, be very finely pulverized in an agate mortar, then placed upon a piece of turmeric paper and moistened with a drop of pure water, strong indications of free alkali will be obtained; and that if the pulverization be very perfect, the alkali can be detected in other kinds of glass, containing far smaller quantities of it. This proves, that in whatever state of combination the alkali may be, it is still subject to the action of moisture. That flint-glass is by no means a compound resulting from very strong chemical affinities, and that the oxide of lead which it contains is as imperfectly combined as the alkali, has been shown experimentally by Mr. Faraday, and also appears from the tarnish which is produced on its surface by exposure to sulphuretted vapours, owing to the combination of sulphur with the lead. Glass which has long been exposed to the weather, frequently exhibits a beautiful iridescent appearance, and is so far decayed, that it may be

scratched with the nail. The glass of some bottles of wine which had lain in a wet cellar near the Bank of London upwards of 150 years, examined by Mr. Brande, was soft, and greatly corroded upon the surface, in consequence of the partial abstraction of its alkali. After reciting some of these facts, and others of a similar description, Mr. Faraday observes, "Glass may be considered rather as a solution of different substances one in another, than as a strong chemical compound; and it owes its power of resisting [chemical] agents generally, to its perfectly compact state, and the existence of an insoluble and unchangeable film of silica, or highly silicated matter, upon its surface." See Mr. Faraday's Bakerian Lecture on the manufacture of glass for optical purposes; Phil. Trans. 1830, pp. 46—50.—*Parke's Chem. Cat, by Brayley. (Arcana, &c.* 1835.)

Carriage Wheels.

On the 27th of May, at the Institution of Civil Engineers, Mr. Walker's paper, on the subject of the most advantageous form for wheels of different kinds of carriages, having been read, a member remarked that there were some practical objections to the use of horizontal axles, which were not alluded to in Mr. Walker's communication—one, the difficulty of making the wheel perfectly secure from coming off the axle, as a greater strain is unavoidably thrown on the linchpin. The wheels of ordinary country wagons are usually much dished, and the axles slightly inclined downwards, by which arrangement, the principal strain is thrown on the shoulder of the axletree, and a very ordinary description of linchpin will answer the purpose. As far as regards friction, and, consequently, an easy draught for the horse, the straight axle and cylindrical wheel have the preference; but, for safety, strength, and durability, he thought the inclined axle and dished wheel superior; besides which, there exists much practical difficulty in constructing carriages with horizontal axles and cylindrical wheels. It was remarked, that one reason for the conical wheel being so much adhered to in practice, was the greater liability of the tire on the cylindrical wheel to get loose; by the constant rolling of a heavy weight frequently on a small extent of surface, the tire becomes slightly elongated, and, on a cylindrical wheel, gets loose, and may occasion accidents; the conical wheel provides against this, by its greater elasticity, and the tendency it has to become more flat in the dishing, and, in a slight degree, to stretch out the periphery. It was stated that, at first, the cylindrical shape was adopted in Jones' patent iron wheels; but it was found that, with upright wheels, the width of track was required to be seven feet, and some of the streets do not admit of such a vehicle passing; also, in crowded thoroughfares, the nave is exposed, and liable to come in contact with other carriages.—It was stated, that a wheel of a new construction had lately been attempted, and was likely to become an improvement; the rim and nave are of cast-iron, and the spokes of wrought-iron; a wooden band is put round the cast-iron rim, which again is surrounded and fastened on by a wrought-iron tire, secured in the ordinary manner.—It was mentioned that, in Austria, cylindrical wheels are invariably used for wagons and heavy carriages, but for light vehicles the dished wheel is generally preferred.—A member stated, that in the neighbourhood of Edinburgh, the common stone carts belonging to the Cragleith, and other quarries, are generally made with broad cylindrical wheels.

On June 3, the conversation on the subject of the best form for wheels of carriages was resumed. An ingenious method was adopted by Messrs.

Jones, to exhibit the friction occasioned by conical wheels: a carriage was run upon the edges of loose boards, placed side by side; it was shown that, while the board under the middle part of the wheel remained stationary, that at the outside was pushed forward, and the board on the inside, backward; such, however, can only occur when the whole breadth of the wheel touches the ground, which is seldom the case, a wheel of nine inches having frequently a bearing of only three inches, in consequence of the middle tire being made of larger diameter.—*Arcana, &c.*, 1835.

Rutter's Heat Process.

Dr. Daubeny brought before the meeting the economical employment of coal-tar in connexion with water as fuel, according to the method lately suggested by Mr. Rutter.* A discussion then arose as to whether the water in this case acts chemically or mechanically, or both, in facilitating the combustion of the tar. Mr. Macintosh stated, that by repeated experiments he had found, that coal-tar gave no more heat when burned than an equal weight of *splint* coal, the kind preferred, where a long continued heat is required. Mr. Low also stated, that from long experience he could affirm, that the use of water along with coal-tar was productive of no benefit whatever, and that 3 gallons, or 33 lbs. of coal-tar, give an equal amount of heating effect, fully, to 40 lbs. of coke, made from the Newcastle coal of the Hutton seam. From the discussion on this subject, which was protracted for some time, it appears to be established, 1. That tar may be used as fuel, but that it does not give much more heat than the same weight of the best coal. 2. That when mixed with water, it flows more easily through tubes, but does not appear to evolve more heat than when used alone.—*Jameson's Journal.*

Progress of Physical Science.

On some elementary laws of Electricity, by W. Snow Harris, Esq. F. R. S. &c.

Mr. Harris has opened some new views of Electricity by decidedly original experiments; he concludes that many of the phenomena treated in the course of his paper do not seem to have been contemplated in the more perfect theories of Electricity.

The new instruments invented by Mr. Harris to render research more easy and results certain and measurable are 1. A new electrometer by divergence. 2. An electrometer measuring directly the attractive force of an electrified body in terms of a known standard of weight, estimated in degrees upon a graduated arc. 3. A unit of measure for electrical charges, furnished by a small jar with an attached discharging electrometer. 4. A balance electrometer. By the aid of these instruments, or of a combination of them with other general means of experiment, and with the electro-thermometer previously invented, the following laws have been established.

1. When the amount of surface of an electrical conductor is varied, or the quantity of electricity distributed upon a given surface, the figure of the surface being the same, the force of attraction for other bodies varies inversely as the square of the relative superficies.

Thus a given quantity of electricity being divided between two conductors

* Originally suggested by Capt. Morey, of New Hampshire.

of equal surface, each one exerts an attractive force of only fourth that which is exerted when the same quantity is distributed upon a single conductor.

This law Mr. Harris considers to be connected with the following facts. That the force of attraction exerted between the two bodies, one of which is electrified, is more or less diminished by the presence of a neutral, or other body, sharing the attraction. This leads him to distinguish three elements peculiar to the conditions of electrical accumulation. 1st. The comparative quantity actually accumulated. 2nd. The quantity not sensible to the electrometer. 3d. The quantity appreciable by the electrometer. The first he calls *quantity;* the second *controlled quantity* or *controlled action;* and the third *free quantity* or *free action.* Mr. Harris limits the term *electrical tension* to "the electric force of a given quantity accumulated in a given space." The term *intensity* is different from this being "applied to the indications of an electrometer and immediately referable to what [he] has called the free action," that is to the operation of either a part, or the whole of the total force in a given direction, up to the point of discharge." The "intensity" by the law above stated varies as the square of the density of the electrical stratum or as the square of the "tension." In connexion with this subject Mr. Harris examines Singer's theory that the diminished intensity observed in disposing a given quantity of electricity on an extended surface is referable to the attractive force of the atmosphere, to the influence of which the electric particles become more extensively exposed. This view he finds to be inconsistent with direct experiment as it is also with the law above stated.

2. The heating effects of the same quantity of electricity is the same, the number of jars, and length of circuit through which the discharge is made, being the same. A change in the tension of the electricity produces no change in heating effect. This fact had previously been shown by Faraday, in regard to the magnetic and chemical effects of electricity.

3. The distances of discharge between two electrified conductors varies directly as the quantity accumulated upon a given surface. The distance through which an electrical accumulation can discharge itself in air of a given density is an accurate measure of the comparative quantity in a unit of surface. The same law of relation holds when the surfaces are varied, thus the distance of discharge is invariably as the discharging surface, for a given quantity of electricity. This third law is consistent with the first.

4. It follows from the third law that the resistance of the atmosphere to the passage of electricity, is the same for all distances, being produced simply by its pressure.

When the density of the air is diminished, the distance of discharge (striking distance) varies inversely as the density, the quantity of electricity accumulated on a given surface being the same. The quantities of electricity required to overcome a given striking distance vary directly as the density of the air. These conclusions accord with the first law.

The temperature of air has no effect on its conducting power for electricity otherwise than as it changes the density. If therefore heat be material it is a non-conductor of electricity, not impairing the insulating power of air which contains it.

5. The resistance of conductors to the passage of electricity is of a different kind from that of air and other non-conductors; it is, other things being the same, directly as the length of the circuit.

Heat impairs the conducting powers of conductors for electricity, as has been asserted by Davy and Professor Christie, but denied by Professor Ritchie.

6. The attractive force of plane conductors of a given area charged with a given quantity of electricity varies with the figure, being greater as the perimeter is greater. This force is therefore least when the area forms a circle and greatest when it is extended into an indefinite right line. The perimeters being the same the attractive forces (intensities) are inversely as the areas.

The electrical capacities of a sphere or cylinder (that is the quantity which they can receive with a given intensity,) are the same as of the plane figures into which it may be supposed to be rectified.

[TO BE CONTINUED IN OUR NEXT.]

Mechanics' Register.

List of American Patents which issued in October, 1835.

		Oct.
589.	*Double Speeder.*—William Field, North Providence, Rhode Island,	6
590.	*Lampwicks, raising.*—Samuel Rust, New York,	6
591.	*Pelisse Wadding.*—Stukley Turner, Cranston, Providence County, R. I.	6
592.	*Planing Boards, &c.*—Reid R. Throcmorton, New York,	6
593.	*Fire Places.*—Ebenezer S. Greely, Dover, Penobscot, Maine,	6
594.	*Clover Seed, &c. cleaning.*—Moses Davenport, Philips, Somerset Co., Maine,	6
595.	*Silk worms, rearing.*—Gamaliel Gay, Poughkeepsie, New York,	6
596.	*Saw Mill.*—Uri Emmons, New York.	6
597.	*Thrashing &c. Machine.*—Russel Bradley, Williston, Vermont,	6
598.	*Spring Saddle.*—Joel Woodward, Marshalton, Pennsylvania,	6
599.	*Stave and Shingle Machine.*—John Everhart, J. Pearson, J. Morford and N. Everhart, Wayne, Ohio,	6
600.	*Alcohol from Apples.*—Anson Wolcott, East Bloomfield, New York,	6
601.	*Ploughs.*—William Walker, Washingtonville, Pennsylvania,	6
602.	*Caoutchouc, cutting.*—William Atkinson, New York,	6
603.	*Ropes, laying.*—John Goulding, Boston, Massachusetts,	10
604.	*Hemp, &c. halcheling.*—John Goulding, Boston, Massachusetts,	10
605.	*Horse Power.*—Moses Davenport, Philips, Somerset County, Maine,	10
606.	*Tin Baker.*—Nathaniel D. Whitin, New York,	10
607.	*Cooking Stove.*—Elnathan Samson, St. Lawrence County, New York,	10
608.	*Clover Seed, &c. thrashing.*—Asa Burgess and Herman Baldwin, Litchfield County, Connecticut,	10
609.	*Hydrostatics and Pneumatics.*—R. Mills H. B. Fernald, City of Washington,	10
610.	*Washing Machine.*—John O. Geer, Norwich, Connecticut,	10
611.	*Staves, cutting.*—George Pack, Sullivan, New York,	10
612.	*Rail-roads.*—Roswell Bourne, Lancaster, Massachusetts,	10
613.	*Churn.*—Asahel Bacon, Windsor, New York,	10
614.	*Rotary Steam Engine.*—Arnold Buffum, Philadelphia, Pennsylvania,	10
615.	*Doffer for Wool Cards.*—Stephen R. Parkhurst, Providence, Rhode Island,	10
616.	*Grates or Grate Bars.*—Jordan L. Mott, New York,	14
617.	*Roads, constructing.*—Thomas Earl, Burlington, New Jersey,	14
618.	*Cast-iron Window sash.*—James S. Stoddard, Macedon, New York,	14
619.	*Canal Boats.*—James O'Connor, Philadelphia,	14
620.	*Springs of Carriages.*—Henry Pace, Senr. Cincinnati, Ohio,	14
621.	*Lathe.*—James Haven, Newport, New Hampshire,	14
622.	*Rail-road Car.*—George W. Cleaveland, Baltimore, Maryland,	14
623.	*Stove, or Furnace.*—Denison Olmsted, New Haven, Connecticut.	14
624.	*Gimblets and Augers.*—Orville B. Percival, East Haddam, Connecticut,	14
625.	*Washing Machine.*—Henry Ault, Philadelphia, Tennessee,	14
626.	*Fire Arms.*—Samuel Ladd, Waltham, Massachusetts,	14
627.	*Felloes, cutting.*—J. S. Brown and J. T. Barker, Philips, Maine,	14
628.	*Mill for Coffee, &c.*—David Richmond, M'Arthurstown, Ohio,	14
629.	*Felloes cutting.*—W. Braley and M. L. Worthley, Philips, Maine,	14
630.	*Bridges.*—Richard T. L. Witty, Lowell, Massachusetts,	14

631. *Sparks, arresting.*—Hunt C. Wiatt, Weldon, North Carolina, 15
632. *Cooking Stove.*—Horatio B. Wade, Cincinnati, Ohio, 17
633. *Coal Stove, Anthracite.*—Eliphalet Nott, Schenectady, New York, 17
634. *Tanning, preparing Skins for.*—J. C. F. Saloman, Reading, Pennsylvania, 17
635. *Steam Boilers.*—J. C. F. Saloman, Philadelphia, Pennsylvania, 17
636. *Ploughs.*—Jarius S. Tefft, Amherst, New York, 17
637. *Washing Machine.*—Isaac Spicer, Norwich, Connecticut, 17
638. *Screw for Glass Knobs.*—Orrin Newton, Pittsburg, Pennsylvania, 17
639. *Cement for Cisterns, &c.*—W. H. Carson and G. Roberts, York, New York, 17
640. *Biscuit, &c. cutting.*—T. Havener and T. H. Havener, Washington City, 17
641. *Calendering Cloth.*—Zenas Bliss, Johnston, Rhode Island, 17
642. *Roofs, covering.*—Phinehas Burgess, Brooklyn, New York, 17
643. *Crackers, &c. cutting.*—William R. Nivens, New York, 17
644. *Feathers, cleaning.*—George Reynolds, East Hartford, Connecticut, 17
645. *Planing boards, &c.*—Reid C. Throckmorton, New York, 22
646. *Bricks and Tile.*—Benton P. Coston, Sterling, Pennsylvania, 22
647. *Surveyor's Compass.*—Samuel R. Miller, Port Royal, Virginia, 22
648. *Tubes and Hinges.*—William Shaw, Buffaloe, New York, 27
649. *Mortising Timber.*—John M'Clintic, Chambersburg, Pennsylvania, 27
650. *Cars, &c. propelling.*—Alexander M'Grew, Cincinnati, Ohio, 27
651. *Sawing Stone.*—Daniel Bunnel, Xenia, Ohio, 27
652. *Sugar, &c. boiling.*—John Steele, jr. New York, 27
653. *Stove.*—Philip Benedict, Lancaster, Pennsylvania, 27
654. *Oven.*—Jacob Baldwin, New York, 27
655. *Boots, &c. cutting.*—Josiah T. Buck, New Canaan, Connecticut, 27
656. *Horse Collars.*—Caleb Angerine, New York, 27
657. *Moulds for Sugar, &c.*—Charles Duncan, Williamsburg, New York, 27
658. *Power Motion Machine.*—David Russell, Tuscambia, Alabama, 27
659. *Portable Saw Mill.*—David Russel, Tuscambia, Alabama, 27
660. *Rail-road Carriage.*—William T. James, New York, 27
661. *Fire-place.*—John Chapin Howard, Howard's Valley, Connecticut, 27
662. *Cotton Whipper.*—Luccan Osgood, Pomfret, Connecticut, 27
663. *Cotton Seed, hulling.*—A. Miller and T. Lawes, Washington County, Miss. 27
664. *Plough Coulters, &c.*—Samuel A. Sperry, Washtenaw, Michigan Territory, 28
665. *Lock for Drawers.*—Edward Brown, Lynchburg, Virginia, 28
666. *Cloths, drying.*—Stephen R. Parkhurst, Worcester, Massachusetts, 28
667. *Planing Machine.*—Ira McLaughlin and Hiram Hill, Sunderland, Vermont, 28
668. *Staves, dressing.*—Joseph Sweet, Lycoming County, Pennsylvania, 28
669. *Corn, crushing, &c.*—Anderson P. H. Jerdon, Madisonville, Tennessee, 28
670. *Cement.*—Charles Clinton, Minnisink, New York, 28
671. *Horse Power.*—A. Trahern, H. Heberling, Wm. E. Lukins and J. Heberling Harrison County, Ohio, 28
672. *Ploughs.*—John W. Jardan, Lexington, Virginia, 28
673. *Gridiron, rotary.*—Kellog Strong, Meriden, Connecticut, 28
674. *Cutting Teeth, &c.*—Andrew T. Mitven, Lycoming County, Pennsylvania, 28
675. *Pumps.*—Joseph Redelsperger, Mansfield, New Jersey, 28
676. *Rotary Pump.*—C. Peters and Benjn. Dean, Poughkeepsie, New York, 28
677. *Truss, spring.*—Henry Reid, Augusta, Georgia, 28
678. *Comb, metallic.*—Nathaniel Bushnell, Middletown, Connecticut, 28
679. *Taylor's Measure.*—Frederic A. Fairchild, Columbus, Georgia, 28
680. *Steel Yard.*—C. F. Dahl, Pittsburg, Pennsylvania, 28
681. *Stove, or Fire Place.*—Daniel Sutherland, Lisbon, Maine, 28

TO READERS.

Owing to the press of original matter for the present number of the Journal, it has been necessary to omit many selections prepared for the number. This has been done in those departments which are most copiously represented in the original matter.

The next number will contain a further portion of the report of the Committee on the explosions of Steam-boilers.

The *Mechanics' Register* will also be supplied with selections at present unavoidably excluded. Com Pub.

CELESTIAL PHENOMENA, FOR FEBRUARY, 1836.*

Calculated by S. C. Walker.

Day.	H'r.	Min.					
3	7	4	N. App. ☽ and 42 Leonis,	,6,	☽ N.	1'.6	V.
3	12	41	Im. i. Leonis,	,6,		47°	33°
3	14	4	Em.			247	280°
8	16	13	Im. ♄ Libræ,	,6,		70	53°
8	17	27	Em.			220	221°
28	6	27	Im. λ Cancri,	,6,		76	19°
28	7	52	Em.			268	219°

Meteorological Observations for October, 1835.

Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind: Direction.	Force.	Water fallen in rain.	State of the weather, and Remarks.
	☉		☽				Inches.	
1	39°	57°	Inches 29.65	Inches 29.50	W.	Brisk.		Lightly cloudy—flying clouds.
2	38	53	.43	.43	SW.	do.		Lightly cloudy—flying clouds.
3	43	54	.46	.50	W.	do.		Clear—flying clouds.
4	43	62	.50	.50	SW.	Moderate.		Cloudy—flying clouds.
5	53	69	.70	.66	do.	do.		Cloudy—rain with high winds.
6	63	58	.76	.70	S.	do.		Rain—cloudy.
7	49	55	.45	.55	SW. W.	do.		Flying cloud—cloudy.
8	39	54	.20	.90	SW.	do.		Clear day.
9	39	56	.95	30.05	W.	do.		Clear day.
10	42	62	30.10	.05	W.	do.		Clear—hazy
11	44	66	30.00	.00	W. SW.	do.		Hazy—do.
12	49	59	29.90	29.90	SW.	do.		Cloudy—clear.
13	52	61	30.14	.16	NE.	do.		Cloudy—lightly cloudy.
14	44	70	.15	30.05	SW.	do.		Hazy—do.
15	56	64	.00	.00	SW.	do.		Cloudy—hazy.
16	56	70	.00	.00	SE.	do.		Cloudy—do.
17	52	63	.02	.10	E. NE	do.		Cloudy—do.
18	61	74	.00	.10	SE.	do.		Cloudy—rain—flying clouds.
19	63	75	.05	.05	S. SW.	do.	.05	Cloudy—cloudy.
20	60	76	29.98	29.94	SE.	do.		Fog—hazy.
21	63	75	30.06	30.06	SE.	do.		Cloudy—lightly cloudy.
22	60	70	.06	.12	SE.	do.		Fog—cloudy.
23	54	63	.10	.10	SE.	do.		Cloudy—lightly cloudy.
24	47	60	29.97	29.97	NW.	do.		Fog—cloudy.
25	38	52	30.25	30.25	N.	do.		Cloudy—flying clouds.
26	33	57	.15	.15	SE.	do.		Clear—frost—clear.
27	44	60	.30	.23	SE.	Calm.		Clear—frost—clear.
28	44	62	.30	.30	W.	do.		Clear—clear.
29	45	65	.10	.30	SE.	do.		Partially cloudy—clear.
30	57	62	29.85	.10	W.	Moderate.		Fog—hazy.
31	45	57	.90	30.00	E.	do.	.13	Heavy fog—rain.
Mean	49.57	62.93	29.95	29.93	W.	do.	1.38	Cloudy—clear.

Thermometer.		Barometer.
Maximum height during the month,	76. on 20th.	30.25 on 25th.
Minimum do.	33. on 26th.	29.16 on 12th.
Mean do.	56.22	29.94

* The Celestial Phenomena for 1836, include all the occultations of fixed stars by the Moon to the 6th magnitude inclusive visible at Philadelphia.

The angles under N. and V. respectively denote the angular distance of the point of immersion or emersion, from the *apparent* north or vertical point of the Moon's disc, as seen in a telescope which inverts. These angles are reckoned to the right or apparent west round the circle.

S. C. W.